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17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING N.A.

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SOCIAL SCIENCES

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Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
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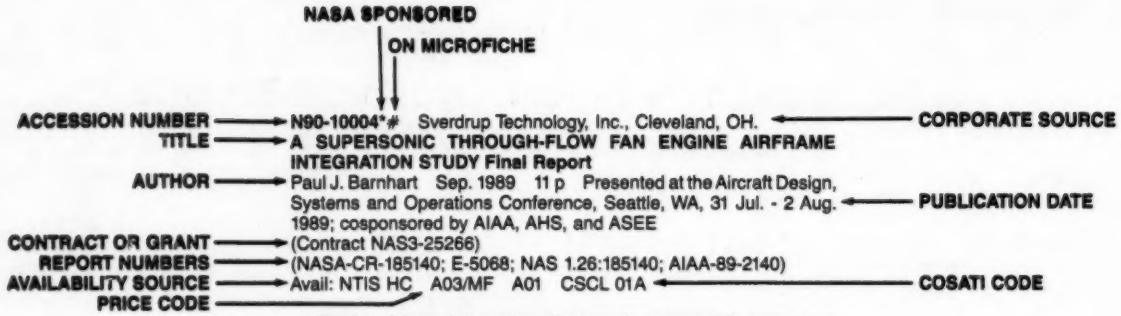
NASA SPONSORED
ON MICROFICHE
ACCESSION NUMBER
N90-10004*# Sverdrup Technology, Inc., Cleveland, OH.
CORPORATE SOURCE
TITLE
A SUPERSONIC THROUGH-FLOW FAN ENGINE AIRFRAME INTEGRATION STUDY Final Report
AUTHOR
Paul J. Barnhart Sep. 1989 11 p Presented at the Aircraft Design, Systems and Operations Conference, Seattle, WA, 31 Jul. - 2 Aug. 1989; cosponsored by AIAA, AHS, and ASEE
PUBLICATION DATE
CONTRACT OR GRANT
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REPORT NUMBERS
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AVAILABILITY SOURCE
Avail: NTIS HC A03/MF A01 CSCL 01A
COSATI CODE
PRICE CODE

Engine airframe integration effects are investigated for supersonic through-flow fan engines installed on a Mach 3.20 supersonic cruise vehicle. Six different supersonic through-flow fan engine installations covering the effects of engine size, nacelle contour, nacelle placement, and approximate bypass plume effects are presented. The different supersonic through-flow fan installations are compared with a conventional turbine bypass engine configuration on the same basic airframe. The supersonic through-flow fan engine integrations are shown to be comparable to the turbine bypass engine configuration on the basis of installed nacelle wave drag. The supersonic through-flow fan engine airframe integrated vehicles have superior aerodynamic performance on the basis of maximum lift-to-drag ratio than the turbine bypass engine installation over the entire operating Mach number range from 1.10 to 3.20. When approximate bypass plume modeling is included, the supersonic through-flow fan engine configuration shows even larger improvements over the turbine bypass engine configuration. Author

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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N90-25072* National Aeronautics and Space Administration, Washington, DC.
AERONAUTICAL ENGINEERING: A CUMULATIVE INDEX TO A CONTINUING BIBLIOGRAPHY (SUPPLEMENT 248)
Feb. 1990 525 p
(NASA-SP-7037(248); NAS 1.21:7037(248)) Avail: NTIS HC A22; NTIS standing order as PB89-914100, $16.50 domestic, $33.00 foreign CSCL 01B

This publication is a cumulative index to the abstracts contained in Supplements 236 through 247 of Aeronautical Engineering: A Continuing Bibliography. The bibliographic series is compiled through the cooperative efforts of the American Institute of Aeronautics and Astronautics (AIAA) and the National Aeronautics and Space Administration (NASA). Seven indexes are included -- subject, personal author, corporate source, foreign technology, contract number, report number and accession number. Author

N90-25073# Technion - Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering.
CONVEX MODELS OF MALFUNCTION DIAGNOSIS IN HIGH PERFORMANCE AIRCRAFT Final Report
Yakov Ben-Haim May 1989 77 p
(Grant AF-AFOSR-0209-88)
(AD-A218514) Avail: NTIS HC A05/MF A01 CSCL 01/3

This project is devoted to the study of diagnosis of additive malfunctions in linear dynamic systems. This class of failures is relevant to control-actuator failures in aircraft, as well as to other situations. In particular, we are interested in optimizing multi-hypothesis maximum-likelihood algorithms for malfunction diagnosis, since this concept is the most widely accepted basis for automatic malfunction diagnosis. The engineering system to be studied is a linearized aerodynamic model for small disturbances about a reference condition of steady rectilinear flight over a flat earth. The advantage of this system is its simple description of a wide range of aerodynamic situations, and the fact that control-actuator malfunctions can be modelled as additive failures. GRA

N90-25074# Naval Postgraduate School, Monterey, CA.
AIRCRAFT MODIFICATIONS COST ANALYSIS. VOLUME 1: OVERVIEW OF THE STUDY Final Report
Dan C. Boger and Shu S. Liao Feb. 1990 37 p
(AD-A220764; NPS-54-90-005) Avail: NTIS HC A03/MF A01 CSCL 01/3

As the budget for the development and production of new military aircraft tightens, modification of existing aircraft (MOD) has become increasingly important. This shift in emphasis has created a need for a high level parametric cost estimating method to estimate the cost of a MOD program early in the planning cycle. This report is the first volume of a series of reports documenting a multi-year project to support Naval Air Systems Command initiative to develop parametric cost estimating models for MOD programs. This volume provides an overview of the project, including a review of prior studies, the structure of data to be collected, and the forms used in data collection. Due to the proprietary nature of MOD program cost data, distribution of all future volumes of the report series except for the summary volume will be limited to selected Department of Defense agencies only. (jg) GRA

N90-25075# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Abt. Forschung und Entwicklung.
RESEARCH AND DEVELOPMENT: TECHNICAL AND SCIENTIFIC PUBLICATIONS 1989 [FORSCHUNG UND ENTWICKLUNG: TECHNISCHE-WISSENSCHAFTLICHE VEROEFFENTLICHUNGEN 1989]
1989 338 p In ENGLISH and GERMAN
(ISSN-0931-9751; ETN-90-96780) Avail: NTIS HC A15/MF A02

Papers on transport aircraft, fighter aircraft, energy, industry and medicine and defense techniques and space aircraft are presented. Topics include: advanced methods for the micromachining of sensors, development of an optimized compact test range, simulation of transport aircraft, microelectronics, video images in real time, Hermes in orbit control system and low pressure plasma. For individual titles, see N90-25076 through N90-25104.

N90-25076# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
A CAX SUCCESS STORY **c61**
Ernst Grill, Johann Flittner, and Walter Rausch *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 9-14 (For primary document see N90-25075 19-01)
(MBB-FW-52/S/PUB-382) Avail: NTIS HC A15/MF A02

The integration of CAD/CAE/CAM (Computer Aided Design/ Computer Aided Engineering/Computer Aided Modelization) using relational databases was studied. An extensive database is presented, which shows how a flexible database solution can be made for the technical scientific area using a combination of existing systems. A practical oriented process was used, which provides an optimal physical lay-out for a database, for a predefined information model and transaction mix. From the test results it is concluded that the more powerful a database system is in its functionality, the more powerful must be its interface to the application programs in order to maintain its efficiency. ESA

N90-25077# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Zentralbereich Technik.
DIODE LASER-PUMPED SOLID-STATE LASERS: A BREAKTHROUGH IN MODERN LASER TECHNOLOGY **c36**
Peter Peuser *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 15-22 Presented at Laser Focus World, Apr. 1989 (For primary document see N90-25075 19-01)
(MBB-Z-0276/89-PUB) Avail: NTIS HC A15/MF A02

The advantages of diode laser-pumped solid-state lasers are experimentally established. Several continuous wave or pulsed lasers were made. Pump efficiencies close to the theoretical limit were achieved. By injection-locking of an Nd:YAG laser and a lamp pumped laser, an output power of 18 W was measured, which is the highest value ever obtained with such a system. This new technology is shown to provide highly efficient, compact,

lightweight and rugged lasers with a long lifetime and excellent beam quality. The potential of miniaturization is shown and an excellent frequency stability was obtained. ESA

N90-25078# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.

DEVELOPMENT AND APPLICATION OF AN OPTIMIZATION PROCEDURE FOR SPACE AND AIRCRAFT STRUCTURES **c61**

Guenter Kneppe, Wolfgang Hartzheim, and Georg Zimmermann *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 23-28 Presented at GAMM-Seminar on Discretization Methods and Structural Optimization, 1989 (For primary document see N90-25075 19-01)

(MBB-FW-522/S/PUB-383) Avail: NTIS HC A15/MF A02

An optimization procedure is presented, that allows the dimensioning of homogeneous isotropic, orthotropic or anisotropic structures and fiber reinforced materials with respect to weight, static, dynamic, aeroelastic and manufacturing requirements. Design variables were sizing and geometric dimensions. The structural and sensitivity analysis was based on the finite element method. Some examples, such as frequency and heat flux optimization of a satellite structure, stress optimization of a wheel, and geometry optimization of an aluminum alloy used for the cabin floor of an aeroplane show the good adaptability of the model for the large scale problems with a high number of design variables and constraints. An integration into the CAE (Computer Aided Engineering) environment by the use of standard interfaces is important for practical applications. ESA

N90-25079# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensgruppe Raumfahrt.

HYBRID ANALYSIS: COUPLING OF THE FINITE ELEMENT METHOD WITH ANALYTICAL APPROACHES **c64**

Stefan Dieker *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 26-36 Presented at AAF DGLR RAeS-European Forum on Aeroelasticity and Structural Dynamics, Aachen, Fed. Republic of Germany, 17-19 Apr. 1989 (For primary document see N90-25075 19-01)

(MBB-UO-0048/89-PUB) Avail: NTIS HC A15/MF A02

The coupling of the finite element method (FEM) with an analytic tool (transfer matrix method) is demonstrated. Analytical approaches are advantageous for undisturbed structures because of the adequate idealization of the structure, high accuracy of results and a small computational effort. The relation between different degrees of freedom (Fourier-coeficients, displacements of grid points) is given by an extension of Bessel's formula. The implementation into FEM programs may be done in three ways, by the application of hybrid elements, by the generation of equivalent finite element method matrices and by the reduction of matrices by shape functions. Some examples are given, such as a dynamic mathematical model of an Ariane booster and the analysis of a filled surface tension tank of a satellite. ESA

N90-25080# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Zentralbereich Technik.

GRADIENT MICROPHONE FOR MEASUREMENT OF THE VECTORIAL SOUND VELOCITY [GRADIENTENMIKROFON ZUR MESSUNG DER VEKTORIELLEN SCHALLSCHNELLE] **c71**

Oskar Bschorr *In its* Research and Development: Technical and Scientific Publications 1989 p 37-40 In GERMAN Presented at 15th the Gemeinschaftstagung mit Kolloquium der Deutschen Arbeitsgemeinschaft fuer Akustik, Duisburg, Fed. Republic of Germany, 13-16 Mar. 1989 (For primary document see N90-25075 19-01)

(MBB-Z-0259/89-PUB) Avail: NTIS HC A15/MF A02

The vectorial velocity of forced oscillations created by a spheric microphone in an acoustic field is studied. When the wavelength is very superior to the radius, the velocity is directly proportional to the local velocity vector of the acoustic field. With a sound pressure microphone the vectorial intensity flux can also be evaluated. ESA

N90-25081# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Zentralbereich Technik.

ADVANCED METHODS FOR THE MICROMACHINING OF SENSORS **c31**

Helmut Seidel and Laszlo Csepregi (Fraunhofer-Inst. fuer Mikrostrukturtechnik, Berlin, Germany, F.R.) *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 41-46 Presented at 7th Sensor Symposium, Tokyo, Japan, 30-31 May 1988 (For primary document see N90-25075 19-01)

(MBB-Z-0281/88-PUB) Avail: NTIS HC A15/MF A02

A short overview of some important methods for the fabrication of micromechanical devices and microsensors is presented. Results are given on the combination of laser machining with anisotropic etching, allowing the manufacturing of precisely shaped, deep, narrow holes through silicon, the advantages of which are the cost effectiveness achievable by batch processing combined with the opportunities of miniaturization and the integration of electrical, mechanical, and optical functions. Some examples of stress adjustment in highly boron doped epitaxial layers and in silicon nitride are given. The combination of high depth x ray lithography and plating avoids the limitations of silicon, due to material properties and crystal symmetry, but is very expensive. ESA

N90-25082# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Zentralbereich Technik.

CHARACTERIZATION OF THE CREEP COMPLIANCES J22 AND J66 OF ORTHOTROPIC COMPOSITES WITH PEEK AND EPOXY MATRICES USING THE NONLINEAR VISCOELASTIC RESPONSE OF THE NEAT RESINS **c24**

Alexander Horoschenkoff *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 47-52 (For primary document see N90-25075 19-01)

(MBB-Z-0258/89-PUB) Avail: NTIS HC A15/MF A02

Creep tests on laminates with varied fiber orientations and stress levels must be evaluated to correctly describe the viscoelastic behavior of composite materials. The tensile creep behavior of two resins used as matrices in high performance carbon fiber reinforced composites was characterized by Schapery's constitutive equation as to nonlinear viscoelasticity. Two equations from the micromechanics of composites were modified by involving a nonlinear viscoelastic matrix and used to predict the nonlinear creep compliances J22 and J66 of orthotropic carbon fiber reinforced composites. The parameters and the nonlinearity factors were found by the least square techniques. The results show a good accuracy of the predictions. ESA

N90-25083# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensgruppe Raumfahrt.

MARS, AN AI-BASED MISSION ACTIVITIES AND RESOURCE SCHEDULER **c12**

Norbert Schielow, Friedrich Zapp, and Albrecht Kellner *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 53-62 Presented at ESTEC Workshop on Artificial Intelligence: Applications for Space Projects, Noordwijk, Netherlands, 15-17 Nov. 1988 (For primary document see N90-25075 19-01)

(MBB-0060/89-PUB) Avail: NTIS HC A15/MF A02

The planning algorithm and the method to propagate time constraints are described, and practical results and experiences achieved by using the MARS system, which aims at the automatic generation of mission plans including crew activity plans and experiment timelines under consideration of a large multitude of time and resource constraints, are given. Data can be structured into hierarchical interconnected levels such as: phases, tasks, subtasks, and activities. The MARS system performs extensive syntactic and semantic consistency checks on these data. ESA

N90-25084# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensbereich Transport und Verkehrsflugzeuge.

SHORT TIME-DYNAMOMETER SYSTEM FOR SHOCK WAVE CHANNELS [KURZZEIT-KRAFTMESSSYSTEM (SFS) FUER STOSSWELLENKANAELE (LESS THAN 10 MS)] **c35**

Joseph Mertens and Klaus Koenig *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 63-68 In GERMAN Presented at DGLR-Fachausschusses Versuchswesen der Fluid- und Thermodynamik, Goettigen, Federal Republic of Germany, 1989 (For primary document see N90-25075 19-01)

(MBB-UT-115/89-PUB) Avail: NTIS HC A15/MF A02

A system for the measurement of aerodynamic forces and moments is developed, based mainly on acceleration. The modal analysis and the optimization of the model is done by finite element calculations. The check of the modal characteristics of the model is done by vibration tests and improvement of the finite element modelization. The influence matrices are calculated with consideration of the calibration tests. A vibration test allows the estimation of the acceleration measurement and improvement of the modelization. ESA

N90-25085# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.

DEVELOPMENT OF AN OPTIMIZED COMPACT TEST RANGE **c32**

Evert Dudok, Dietmar Fasold, and Hans-Juergen Steiner *In its* Research and Development: Technical and Scientific Publication 1989 1989 p 69-76 Presented at the 11th ESTEC Antenna Workshop on Antenna Measurements, Gothenburg, Sweden, 20-22 Jun. 1988 (For primary document see N90-25075 19-01)

(MBB-0053/88-PUB) Avail: NTIS HC A15/MF A02

A method of measuring the electromagnetic far field characteristics of microwave antennas is introduced by means of compact test ranges. The performances of the front-fed Cassegrain system, which avoids the usually weak cross-polarization performance of the compact range geometries, are established. The chosen manufacturing process, milling of cast-iron reflectors, guaranteed highest achievable surface accuracies, even for very large reflectors. The structural analysis showed that extremely high surface accuracies require well regulated temperature conditions of the experiment. ESA

N90-25086# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.

NSFLEX: AN IMPLICIT RELAXATION METHOD FOR THE NAVIER-STOKES EQUATIONS FOR A WIDE RANGE OF MACH NUMBERS **c34**

Manfred A. Schmatz *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 77-84 Presented at the 5th GAMM-Seminar on Numerical Treatment of the Navier-Stokes Equations, Kiel, Fed. Republic of Germany, 20-22 Jan. 1989 (For primary document see N90-25075 19-01)

(MBB-FE-122/S/PUB-366) Avail: NTIS HC A15/MF A02

The extension of the NSFLEX method to hypersonic flows is described for simple two-dimensional and complex three-dimensional configurations. Real gas effects were incorporated in the model. The Reynolds-averaged Navier-Stokes equations were employed for turbulent flows with an algebraic turbulence model. To evaluate the inviscid fluxes a Riemann problem was solved at the finite volume faces. For the very strong shocks which occur at hypersonic flow conditions, a hybrid Steger-Warming local characteristic flux was used to avoid negative pressures in the transient phase. The viscous fluxes were made with central differences at each cell face. The infactored implicit equations were solved in time-dependent form by a Gauss-Siedel relaxation technique. The method was applied successfully to the Hermes configuration for several Mach numbers. ESA

N90-25087# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.

SOLUTION OF THE OPTIMAL CONTROL PROBLEM USING THE SOFTWARE PACKAGE STOMP **c64**

Kathleen Horn *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 101-106 Presented at the 8th IFAC Workshop on Control Applications of Nonlinear Programming and Optimization, Paris, France, 7-9 Jun. 1989 (For primary document see N90-25075 19-01)

(MBB-FE-126/S/PUB-370) Avail: NTIS HC A15/MF A02

The STOMP program is an extension of the TOMP (Trajectory Optimization by Mathematical Programming) package. Gradients are generated by forward difference estimates in which the ordinary differential equations are solved for the perturbed and nonperturbed systems. The STOMP program was applied to a benchmark reentry problem, characterized by moderately long flight times and smooth differential equations. The state variables were the downrange, the altitude, the velocity, flight path angle and absorbed heat. The example was used for the application of several new aspects in the control function modeling in STOMP, such as the movable grid point feature. The grid points can play an important part in locating the position of control points at which sudden changes are activated. The computing time is reduced and the accuracy in gradient evaluation is improved. ESA

N90-25088# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.

FEASIBILITY OF A SYNTHETIC APERTURE RADAR WITH ROTATIVE ANTENNAS (ROSAR) **c32**

Helmut Klausing and Horst Kaltschmidt *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 107-113 Presented at AGARD-Avionics Panel Symposium on High Resolution Air and Spaceborne Radar, The Hague, Netherlands, 8-12 Mar. 1989 Sponsored in cooperation with DLR, Oberpfaffenhofen, Fed. Republic of Germany (For primary document see N90-25075 19-01)

(MBB-S/PUB-0385) Avail: NTIS HC A15/MF A02

ROSAR is a synthetic aperture radar concept based on rotating antennas of a helicopter for target detection and localization with high resolution. The antennas are assembled at the tips of the rotor blades whereby a circular ring shaped swath is illuminated. The actual illumination geometry depends on the altitude above ground, the elevation antenna pattern and the depression angle. An experiment with a real rotating antenna and a monostatic pulsed radar was carried out. Four corner reflectors were positioned for demonstration of the azimuth resolution. The resolution of a real array was obtained by the antenna beamwidth. The azimuth resolution was found to be approximately 153 m but the reflector resolution was not achieved. ESA

N90-25089# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (Germany, F.R.). Unternehmensgruppe Transport- und Verkehrsflugzeuge.

SIMULATION OF TRANSPORT AEROPLANES [SIMULATION VON TRANSPORTFLUGZEUGEN] **c03**

Robert Luckner *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 115-122 In GERMAN Presented at ASIM-Arbeitskreis-Treffen Simulation Technischer Systeme, Stuttgart, Fed. Republic of Germany, 2-3 Mar. 1989 (For primary document see N90-25075 19-01)

(MBB-UT-007/89-PUB) Avail: NTIS HC A15/MF A02

A realtime development simulator is described. It is made of three simulation computers, a simulation software, a cockpit with sight simulation, noise system, interfaces and reading and service unities, and test plants with avionic testbench, avionic signal conversion and test computer, test control computer, test registration and analysis computer. Other devices are tested, such as flight augmentation computer, center of gravity control system, flutter margin augmentation system, fly-by-wire computer, hydraulic actuator. The calculation programs simulate physical properties by mathematical models, such as elastic structure of the plane,

aerodynamic forces and moments and inertia moments. The simulations made on the Airbus planes are shown to be successful. ESA

N90-25090# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
INVESTIGATION ON SHEET MATERIAL OF 8090 AND 2091 ALUMINIUM-LITHIUM ALLOY **c26**
Walter Zink, Juergen Weilke, Lueder Schwarmann, and Karl Heinz Rendigs *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 123-132 Presented at AGARD Conference, Mierlo, Netherlands, 2-7 Oct. 1988 (For primary document see N90-25075 19-01)
(MBB-UT-122/89-PUB) Avail: NTIS HC A15/MF A02

Test results are presented for semi-finished sheet material products compared with alloy 2024 T3 as reference material. The new aluminum-lithium alloys offer considerable weight gain potential without extensive conversions of their manufacturing facilities. Tensile and fatigue tests were carried out. Compression and bearing strength, fatigue on lap joints, crack growth behavior, fracture toughness and intergranular corrosion were particularly studied. It is concluded that 8090 C alloy must be incorporated in the major fatigue test specimen of the Airbus 330 and 340. ESA

N90-25091# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (Germany, F.R.). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
DAMAGE TOLERANCE DEMONSTRATION FOR A310-300 CFPR COMPONENTS **c24**
Oguz Goekgoel *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 133-140 Presented at ICAF Symposium, Jerusalem, Israel, 1989 (For primary document see N90-25075 19-01)
(MBB-UT-012/89-PUB) Avail: NTIS HC A15/MF A02

The treatment of damages concerning allowable sizes and quality assurance in production of CERP (Carbon Fiber Reinforced Plastics) fin box is presented. Severe failure cases were investigated by finite element method analysis, such as rudder attachment lugs or attachment lugs to fuselage failing. Tests were carried out for validation of static strength, fatigue and damage tolerance. Environmental tests with aggressive fluids were performed on composite structures and showed a very small sensitivity to products used on aircraft servicing. Critical damages were calculated for all CFRP fin areas, by using degradation values from panel tests and the safety factors from the finite element method calculations. A schedule of necessary repairs for each type of damage was established. ESA

N90-25092# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
SCENARIO 2000 [SZENARIO 2000] **c05**
Volker vonTein *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 161-170 In GERMAN Presented at Hubschrauberforum, Bueckeburg, Fed. Republic of Germany, 9-10 May 1989 (For primary document see N90-25075 19-01)
(MBB-UD-500/89-PUB) Avail: NTIS HC A15/MF A02

Helicopter programs of the near future are presented. It is predicted that the European military needs must be more important if the European manufactures are to survive. Interesting markets can be found in China or India. The helicopters are more often used as rescue vehicles or police vehicles in Germany, Japan, England or Holland. International cooperation and combination of military and civilian programs are absolutely necessary in future years. ESA

N90-25093# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.
FIRST VULCAIN ENGINE TEST RESULTS **c20**
Helmut Dederra, Dominique Thevenot, and Roberto Sciandra (Fiat Aviazione S.p.A., Turin, Italy) *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 211-222 Presented at the 39th International Astronautical Federation Congress, Bangalore, India, 8-15 Oct. 1988 (For primary document see N90-25075 19-01)
(MBB-UK-0054/88-PUB) Avail: NTIS HC A15/MF A02

The development status of the gas generator, hydrogen turbopump, and oxygen turbopump tests of the Vulcain cryogenic engine is presented. As regards the gas generator, hydraulic, thermal transient and combustion models are available and flame temperature models were validated by mono-element firing tests. Tests by high pressure gaseous hydrogen or hot gases were carried out for the liquid hydrogen turbopump. The turbopump behavior during chill-down with different inlet pressures and flow rates was considered. For the oxygen turbopump, the main tests achieved were: functional capability and chilling, procedure of rig and facility, acceptable pressure drop through the bearings, acceptable vibration levels during the test, acceptable separation of fluids by dynamic seal package, and acceptable gaseous nitrogen leaks in static conditions and reduction of leaks during shaft rotation. ESA

N90-25094# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.
OVERVIEW ON THE HERMES IN-ORBIT CONTROL SYSTEM **c16**
Eveline Gottzein, Klaus Janschek, and Wielfried Oesterlin *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 223-234 Presented at the 2nd European Aerospace Conference on Progress in Space Transportation, Bonn-Bad Godesberg, Fed. Republic of Germany, 22-24 May 1989 (For primary document see N90-25075 19-01)
(MBB-UK-0056/89-PUB) Avail: NTIS HC A15/MF A02

The spaceplane configuration and the guidance navigation control related mission aspects are described. The Hermes orbital flight controller functional and operational architecture is presented with special consideration of hierarchical and modular design aspects. The orbital phase of the Hermes mission consists of separation, free flight, rendezvous and servicing on the MTFF (Man Tended Free Flyer), de-orbiting and orbital reentry phase. The dynamic/kinematic response of the spaceplane due to control and disturbance torques and forces is measured by the sensors of the navigation system, which also provides estimates for the control variables. The current status of the Hermes orbital flight controller integrates a baseline architectural design, functional definition and low level control algorithms. ESA

N90-25095# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.
PLATO: A EUROPEAN PLATEFORM ORBITER CONCEPT **c18**
Stephen Ransom and Rainer Hoffmann *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 249-260 Presented at AeroTech 89, Birmingham, England, 31 Oct. - 3 Nov. 1989 (For primary document see N90-25075 19-01)
(MBB-UO-0061/89-PUB) Avail: NTIS HC A15/MF A02

PLATO is a small unmanned winged reentry vehicle designed for launch by Ariane. It is intended to conduct material and life science experiments in space and to develop materials, structures and navigation and control techniques for future spacecraft. In the first phase of the feasibility study of PLATO, the ascent, reentry and return flight phases were investigated by means of computer simulations, analyses and low speed wind tunnel tests. These demonstrated a rectangular winged version of PLATO has the best aerodynamic characteristics. The ascent profile was determined by iterative computer simulations which took into account the wind profile at the Kourou launch site. The study shows that simplicity in the realization of the concept and minimization of costs are possible. ESA

N90-25096# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.
CONCEPTS FOR HIGH RESOLUTION SPACE BASED SAR/ISAR SYSTEMS **c32**

Claus Boesswetter, Aribert Paul Wolframm, Timothy Kevin Pike, and Jean Michel Hermer (Thomson-CSF, Montrouge, France) *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 261-270 Presented at AGARD Avionics Panel Symposium on High Resolution Air and Spaceborne Radar, The Hague, Netherlands, 8-12 May 1989 (For primary document see N90-25075 19-01)
(MBB-UK-0057/89-PUB) Avail: NTIS HC A15/MF A02

Different beam pointing techniques, such as monobeam, multibeam in azimuth/elevation are addressed for strip mapping SAR modes as well as for MTI/ISAR modes. Basic requirements for selection of orbits are also discussed. The MTI/ISAR modes is intended to detect and classify from space clusters of fast moving small targets against the clutter background of the earth surface. High along-track resolution is achieved by using an antenna as short as possible in the along-track direction, collecting a large number of return echoes and processing these, according to the regular SAR principle. But the antenna technology and the realtime processing technology necessary to handle the large amount of data generated by multimode resolution systems create difficulties. ESA

N90-25097# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensgruppe Wehrtechnik.
SYSTEM FOR SHOOTING OF VIDEO IMAGES IN REALTIME [SYSTEM ZUR DREHUNG VON VIDEOBILDERN IN ECHTZEIT] **c32**
Peter Wittfoth *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 285-292 In GERMAN (For primary document see N90-25075 19-01)
(MBB-UM-0009/89-PUB) Avail: NTIS HC A15/MF A02

A large image processing module is developed, that generates video images online and allows functions such as correlation, zooms, reduction, distortion correction, and scale. The base of the module is a microprogrammed sequencer that can handle images up to 4096 by 4096 image points. A complete bilinear interpolation of the same image is realized without parallel processing in 60 ms. The areas of utilization are numerous: stereo image evaluation, perspective representation of three-dimensional objects, coordinates transformation, 1-D and 2-D finite impulse response filter. ESA

N90-25098# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Wehrtechnik.
REALTIME SIMULATION AT MBB TODAY AND FUTURE ASPECTS **c61**
Thomas Kuestner *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 293-300 Presented at SIMSIG 89, San Francisco, CA, 22-28 May 1989 (For primary document see N90-25075 19-01)
(MBB-UA-1134/89-PUB) Avail: NTIS HC A15/MF A02

As a connection link between the pure mathematical simulation and the flight tests, the HIL (Hardware In the Loop) simulation makes an essential contribution during the development. A permanent feedback of simulation results reduces the risk of development misses and the risk of flight tests by presimulation. A HIL simulation is characterized by data communication between the simulation computer and the test object (missile). The interfaces must be digital, discrete and analog. A complete control of the data flow of the input/output sequences is achieved by the application program and the absolute deterministic behavior. To minimize the necessary input/output times, high speed data channels to the realtime periphery and to the device under test are required. ESA

N90-25099# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Wehrtechnik.
HIGHEST INTEGRATION IN MICROELECTRONICS: DEVELOPMENT OF DIGITAL ASICS FOR PARS3-LR [HOECHSTINTEGRATION IN DER MIKROELEKTRONIK: ENTWICKLUNGEN VON DIGITALEN ASICS FUER PARS3-LR] **c33**
Peter Scholler and Rainer vonLutz *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 301-304 In GERMAN Presented at Elektronik-Information, Sep. 1989 (For primary document see N90-25075 19-01)
(MBB-UA-1151/89-PUB) Avail: NTIS HC A15/MF A02

Essential electronic system components by PARS3-LR, show high requirements in calculation power, power consumption and reliability, by immediately increasing integration thicknesses. These problems are solved by using integrated circuits, developed by LSI LOGIC, that uses the technical and economic advantages of this leading edge technology. ESA

N90-25100# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensbereich Energie- und Industrietechnik.
POSSIBILITIES OF Nd: YAG LASER UTILIZATION IN MEDICINE [MOEGLICHKEITEN DER ND:YAG-LASERANWENDUNG IN DER MEDIZIN] **c36**
Frank Frank *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 305-308 In GERMAN (For primary document see N90-25075 19-01)
(MBB-UE-0002/88-PUB) Avail: NTIS HC A15/MF A02

The thermic effect caused by the shrinkage and the drying of the tissues is used for cutting, denaturation, and coagulation of tissues with simultaneous filling of the blood and lymphatic vessels. The surgical Nd:YAG lasers, whose utilization is based on photothermic effects, have 120 W power and are used in neurosurgery, dermatology, gastroenterology, gynecology, urology, lung sickness, and jaw and vessel surgery. The treatment of tumors is particularly interesting because of the total destruction of the ill tissue, the homogeneity of the necrose and the obturation of the blood and lymphatic vessels. In all cases, the laser is a better solution for the patients and allows a shorter stay in hospital. ESA

N90-25101# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensbereich Energie- und Industrietechnik.
TECHNOLOGY FOR LOW PRESSURE PLASMA PROCESSES, A NEW APPROACH: THE PLASMA BOX CONCEPT **c75**
Achim Bubenzer and Jacques P. M. Schmitt *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 309-312 Presented at the 11th International Vacuum Congress, Cologne, Fed. Republic of Germany, 25-29 Sep. 1989 (For primary document see N90-25075 19-01)
(MBB-UE-0003/89-PUB) Avail: NTIS HC A15/MF A02

Some problems arising in vacuum technology are studied for low pressure plasmas for solid material processing, since these plasma processes have a great influence on measuring and stabilizing of the flow, pressure and composition of the feedstock gases and the actual substrate temperatures, such as pumping of toxic effluent gases. Due to homogeneous gas phase reactions, particulates may form in the plasma. These particles are generally very hard materials with strongly abrasive properties: the pumps must be protected by mounting them outside the line of sight from the plasma. All deposition-type plasma processes are very sensitive to residual gas impurities in the plasma reactor, that contain mostly hydrogen or carbon. A high vacuum pumping stage is necessary. ESA

N90-25102# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensbereich Energie- und Industrietechnik.
NEW APPROACH FOR THE THIN LAYER MANUFACTURING: THE WAFER TELEMETRY SYSTEM [NEUE ASPEKTE BEI DER DUENNSCHICHT-HERSTELLUNG: DAS WAFER-TELEMETRIE SYSTEM] **c33**
Oswald Stoermer *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 313-318 In GERMAN (For primary document see N90-25075 19-01)
(MBB-UE-0004/89-PUB) Avail: NTIS HC A15/MF A02

A system is presented that recognizes electrical properties of the metallic conducting layers during their implementation in the vaporization and cathode dust removal devices. The electric

resistance and the substrate temperature were transmitted from the emitter to a receiver. The obtained data can be submitted for in situ visualization of the process, by means of a calculation or can be used as effective value for an automatic process control. ESA

N90-25103# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
DEVELOPMENT AND TEST OF SOFTWARE BY SAFETY CRITICAL AIRCRAFT SYSTEMS [ENTWICKLUNG UND PRUEFUNG VON SOFTWARE BEI SICHERHEITSKRITISCHEN LUFTFAHRTSYSTEMEN] **c03**
In its Research and Development: Technical and Scientific Publications 1989 1989 p 319-324 In GERMAN Presented at Fachseminar Sicherheitstechnik am Beispiel des Schienenverkehrs: Entwicklung ins naechste Jahrtausend, Brunswick, Fed. Republic of Germany, 18-19 Oct. 1988 (For primary document see N90-25075 19-01)
(MBB-FE-363/S/PUB-384) Avail: NTIS HC A15/MF A02

A software validation and checkout methodology is presented. An aeroplane needs onboard calculator systems for navigation, communication, generation of control signals and system supervision. The software demands some characteristics, such as safety critical point, distributed processing, fast realtime processing, embedded systems, man-machine communication. The security aspects are achieved by software requirements hazard analysis, top level design hazard analysis, detailed design hazard analysis, code level software analysis, software safety testing and software/user interfaces analysis. ESA

N90-25104# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Wehrtechnik.
AERO-ACOUSTIC INVESTIGATIONS OF THE MAGNETIC TRAIN TRANSRAPID 06 **c71**
Hans Alscher *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 325-330 Presented at the 11th International Conference on Magnetically Levitated Systems and Linear Drives, Yokohama, Japan, 8 Jul. 1989 (For primary document see N90-25075 19-01)
(MBB-UW-0009/89-PUB) Avail: NTIS HC A15/MF A02

Dominant sources of aero-acoustic noise are identified on the surface of the magnetic train Transrapid 06 by microphone array measurements, in order to minimize the aerodynamic drag and the noise. Wind tunnel tests were carried out for a specific area near the nose of the train and led to local reshaping. For the measurements, a linear equidistant arrangement of 13 microphones with omnidirectional characteristic. The various signals received are recorded in parallel for later digital processing. Such acoustic investigations necessitate many parameters to be varied: position of array, microphone distances for different frequency ranges, different speeds of the vehicle and different types of guideway construction. A complete combination of all parameters adds up to a great number of test runs. ESA

N90-25105* National Aeronautics and Space Administration, Washington, DC.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 253)
Dec. 1988 167 p
(NASA-SP-7037(253); NAS 1.21:7037(253)) Avail: NTIS HC A08; NTIS standing order as PB90-914100, $11.50 domestic, $23.00 foreign CSCL 01B

This bibliography lists 637 reports, articles, and other documents introduced into the NASA scientific and technical information system in May, 1990. Subject coverage includes: design, construction and testing of aircraft and aircraft engines; aircraft components, equipment and systems; ground support systems; and theoretical and applied aspects of aerodynamics and general fluid dynamics. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N90-25106*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ANALYSIS AND DESIGN OF OPTIMIZED TRUNCATED SCARFED NOZZLES SUBJECT TO EXTERNAL FLOW EFFECTS
Rickey J. Shyne and Theo G. Keith, Jr. (Toledo Univ., OH.) 1990 12 p Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; cosponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-103175; E-5553; NAS 1.15:103175; AIAA-90-2222)
Avail: NTIS HC A03/MF A01 CSCL 01A

Rao's method for computing optimum thrust nozzles is modified to study the effects of external flow on the performance of a class of exhaust nozzles. Members of this class are termed scarfed nozzles. These are two-dimensional, nonsymmetric nozzles with a flat lower wall. The lower wall (the cowl) is truncated in order to save weight. Results from a parametric investigation are presented to show the effects of the external flowfield on performance. Author

N90-25107*# Auburn Univ., AL. Dept. of Aerospace Engineering.
HIGH ALTITUDE OZONE RESEARCH BALLOON
Timothy A. Cauthen, Leslie A. Daniel, Sally C. Herrick, Stacey G. Rock, and Michael A. Varias Jun. 1990 83 p
(Contract NASw-4435)
(NASA-CR-186653; NAS 1.26:186653) Avail: NTIS HC A05/MF A01 CSCL 01A

In order to create a mission model of the high altitude ozone research balloon (HAORB) several options for flight preparation, altitude control, flight termination, and payload recovery were considered. After the optimal launch date and location for two separate HAORB flights were calculated, a method for reducing the heat transfer from solar and infrared radiation was designed and analytically tested. This provided the most important advantage of the HAORB over conventional balloons, i.e., its improved flight duration. Comparisons of different parachute configurations were made, and a design best suited for the HAORB's needs was determined to provide for payload recovery after flight termination. In an effort to avoid possible payload damage, a landing system was also developed. Author

N90-25108# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
STUDIES IN NON-LINEAR UNSTEADY AERODYNAMICS Final Report, Apr. 1986 - Mar. 1988
J. C. Wu Mar. 1989 63 p
(Grant AF-AFOSR-0121-86; AF Proj. 2307)
(AD-A221228; AFOSR-90-0389TR) Avail: NTIS HC A04/MF A01 CSCL 01/1

Two new unified theoretical computational methods for analyzing unsteady aerodynamics involving rapid large amplitude motion of lifting bodies are described. One method is based on the zonal solution of the full Navier-Stokes equation and the other method is a simplified zonal method. Selected results are presented for 2-D rigid, articulate and flexible lifting bodies. Preliminary results for 3-D problems are also presented. Author

N90-25109*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE RECEPTIVITY PROBLEM FOR GOERTLER VORTICES: VORTEX MOTIONS INDUCED BY WALL ROUGHNESS Final Report
James P. Denier, Philip Hall, and Sharon Seddougui May 1990 61 p Submitted for publication Original contains color illustrations

(Contract NAS1-18605)
(NASA-CR-182036; ICASE-90-31; NAS 1.26:182036) Avail: NTIS HC A04/MF A01; 2 functional color pages CSCL 01A

The receptivity problem for Goertler vortices induced by wall roughness is investigated. The roughness is modelled by small amplitude perturbations to the curved wall over which the flow takes place. The amplitude of these perturbations is taken to be sufficiently small for the induced Goertler vortices to be described by linear theory. The roughness is assumed to vary in the spanwise direction on the boundary layer lengthscale, while in the flow direction the corresponding variation is on the lengthscale over which the wall curvature varies. In fact the latter condition can be relaxed to allow for a faster streamwise roughness variation so long as the variation does not become as fast as that in the spanwise direction. The function which describes the roughness is assumed to be such that its spanwise and streamwise dependences can be separated; this enables progress by taking Fourier or Laplace transforms where appropriate. The cases of isolated and distributed roughness elements are investigated and the coupling coefficient which relates the amplitude of the forcing and the induced vortex amplitude is found asymptotically in the small wavelength limit. It is shown that this coefficient is exponentially small in the latter limit so that it is unlikely that this mode can be stimulated directly by wall roughness. The situation at O(1) wavelengths is quite different and this is investigated numerically for different forcing functions. It is found that an isolated roughness element induces a vortex field which grows within a wedge at a finite distance downstream of the element. However, immediately downstream of the obstacle the disturbed flow produced by the element decays in amplitude. The receptivity problem at larger Goertler numbers appropriate to relatively large wall curvature is discussed in detail. Author

N90-25110*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INTEGRAL-EQUATION METHODS IN STEADY AND UNSTEADY SUBSONIC, TRANSONIC AND SUPERSONIC AERODYNAMICS FOR INTERDISCIPLINARY DESIGN
E. Carson Yates, Jr. May 1990 18 p Presented at the Japan/USA Boundary Elements Symposium, Palo Alto, CA, 5-7 Jun. 1990
(NASA-TM-102677; NAS 1.15:102677) Avail: NTIS HC A03/MF A01 CSCL 01A

Progress in the development of computational methods for steady and unsteady aerodynamics has perennially paced advancements in aeroelastic analysis and design capabilities. Since these capabilities are of growing importance in the analysis and design of high-performance aircraft, considerable effort has been directed toward the development of appropriate aerodynamic methodology. The contributions to those efforts from the integral-equations research program at the NASA Langley Research Center is reviewed. Specifically, the current scope, progress, and plans for research and development for inviscid and viscous flows are discussed, and example applications are shown in order to highlight the generality, versatility, and attractive features of this methodology. Author

N90-25111*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
COUPLED ROTOR-BODY EQUATIONS OF MOTION HOVER FLIGHT Interim Report, 2 Feb. 1989 - 30 Jun. 1990
H. C. Curtiss, Jr. and R. M. McKillip, Jr. Jun. 1990 47 p
(Grant NAG2-561)
(NASA-CR-186710; NAS 1.26:186710; PU-TR-1894T) Avail: NTIS HC A03/MF A01 CSCL 01A

A set of linearized equations of motion to predict the linearized dynamic response of a single rotor helicopter in a hover trim condition to cyclic pitch control inputs is described. The equations of motion assume four fuselage degrees of freedom: lateral and longitudinal translation, roll angle, pitch angle: four rotor degrees of freedom: flapping (lateral and longitudinal tilt of the tip path plane), lagging (lateral and longitudinal displacement of the rotor plane center of mass); and dynamic inflow (harmonic components). These ten degrees of freedom correspond to a system with eighteen dynamic states. In addition to examination of the full system dynamics, the computer code supplied with this report permits the examination of various reduced order models. The code is presented in a specific form such that the dynamic response of a helicopter in flight can be investigated. With minor modifications to the code the dynamics of a rotor mounted on a flexible support can also be studied. Author

N90-25112*# Old Dominion Univ., Norfolk, VA. Dept. of Mathematical Sciences.
A REVIEW OF INSTABILITY AND NOISE PROPAGATION IN SUPERSONIC FLOWS Final Report, period ending 31 May 1990
Q. Isa Daudpota and William D. Lakin Jul. 1990 32 p
(Grant NAG1-881)
(NASA-CR-186800; NAS 1.26:186800) Avail: NTIS HC A03/MF A01 CSCL 01A

Originally analytical and numerical models were to be developed for noise production in supersonic jets, wakes and free shear layers. While the effort was concentrated initially on these aspects, other topics were also pursued, most were of interest to the Jet Noise Group of the Aeroacoustics Branch. An overview is given of subjects reviewed and the investigations that were carried out. A significant effort was devoted to numerically predicting the flow field of a turbulent supersonic wall jet. This information is necessary for computing the pressure in the far field. The wall jet was selected because it represents a generic flow that can be associated with plug nozzle in supersonic engines. It combines the characteristic of a boundary layer with that of a free shear flow. The spatially evolving flow obtained using Dash's code would form the input for the stability analysis program. This analysis would determine the large scale instability wave within the flow. The far field pressure can be computed from the shape of the evolving large scale structure by asymptotic methods. Flow characteristics obtained from a program that analyses the turbulent downstream supersonic flow in a nozzle are described and compared with experimental results. Author

N90-25113# European Space Agency, Paris (France).
A LIFTING SURFACE METHOD FOR THE CALCULATION OF STEADY AND UNSTEADY, INCOMPRESSIBLE PROPELLER AERODYNAMICS
Juergen Schoene (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) May 1990 145 p Transl. into ENGLISH from Ein Tragflaechenverfahren zur Berechnung Stationaerer und Instationaerer, Inkompressibler Propellerumstroemung (Brunswick, Fed. Republic of Germany, DFVLR), Jan. 1989 120 p Original language document was announced as N89-25972
(ESA-TT-1151; DFVLR-FB-89-04; ETN-90-97075) Avail: NTIS HC A07/MF A01

A lifting surface method for steady and unsteady propeller flows which enables ascertainment of load distribution on blades of axial-flow individual and counter-rotating propellers is presented. Initially, Prandtl's acceleration potential is referred to for an integral equation for non-chorded lifting surfaces with time-dependent load distribution. Next a method is developed for numerical solution of this equation; for this purpose the lifting surfaces of the propeller blades are divided into panels over which doublets are arranged in a line. The chronologically-varying intensity of these singularities is developed in a Fourier series. Consequently a linear equation system has to be solved, rather than an integral equation. The method was validated by extensive specimen and comparative calculations. Results for wings in straight-line motion, single propellers with steady and unsteady load distributions and for counter-rotating propellers, are presented. ESA

N90-25114# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE FLOW OVER PLANE DELTA WINGS WITH SUPERSONIC

LEADING EDGES

A. C. J. Venis Jun. 1989 79 p
(LR-588; ETN-90-97162) Avail: NTIS HC A05/MF A01

The experimental and theoretical investigation of the flow on both the windward and the leeward side of a supersonic plane delta wing is covered. An experimental test program, on unyawed and yawed delta wings, consisting of surface pressure tests, oil flow tests and pilot-pressure tests, was performed. The theoretical approach is based on a recently developed theory of conical stagnation point solutions. This approach implies the embedding of a local flow solution in a surrounding known flow field. The computer code is implemented and is used in connection with the test series. The agreement of the flow calculations with the experimental data is good. At higher angles of attack the agreement was found to be less accurate. On the wing leeward side the flow is found to be locally shock induced separated for higher angles of attack. The theory is extended to the calculation of the flow over the surface of yawed delta wings. A third order approximation is obtained for the flow over the wing windward side. However, for the flow on the leeward side of the yawed delta wing no satisfactory solution for a general case was obtained. The simple procedure of matching the local solutions to the surrounding flow in a chosen set of specific points yields equations that cannot be solved in all but a few incidental cases. The calculations on the wing windward side are found to be consistent with experimentally obtained data. Experiments are performed on the wing leeward side although no proper comparison with theory is made. ESA

N90-25115# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

INVESTIGATION OF THE VORTEX FLOW OVER A SHARP-EDGED DELTA WING IN THE TRANSONIC SPEED REGIME

W. J. Bannink, E. M. Houtman, and S. P. Ottochian Oct. 1989 66 p
(LR-594; ETN-90-97164) Avail: NTIS HC A04/MF A01

An experimental investigation of high subsonic and transonic flow at the leeside of a sharp edged planar delta wing, having a leading edge sweep of 65 deg is presented. The experiments were performed at Mach numbers from 0.6 to 0.9 and angles of attack up to 20 deg. Surface pressure measurements, oil flow visualizations and Schlieren visualizations were made. Attention was paid to the presence and location of embedded shock waves, vortex breakdown and the interaction of these two phenomena. The status of the boundary layer on the leesurface of the wing was considered. Special emphasis was given to the case with a free stream Mach number of 0.85 since this case attracted special international interest in relation to computer validation. The present experiments did not reveal how the two observed shocks extended in spanwise direction, nor did they show the existence of other embedded shocks (oblique to the free stream direction) measured in earlier investigations by flow field explorations. ESA

N90-25116# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

THE APPLICATION OF THE FINITE ELEMENT METHOD TO AN AERODYNAMIC PROBLEM SPECIFIC TO PROPELLER DESIGN

Cyril M. Wentzel Mar. 1990 58 p
(LR-614; ETN-90-97177) Avail: NTIS HC A04/MF A01

A finite element method was applied and programmed for the solution of a classical problem occurring in propeller aerodynamics: finding the optimum circulation distribution (minimum energy loss in the wake). No specific numerical problems were encountered and the method was verified (linear elements) using classical tables in the literature. The program yields an efficient and flexible means of generating the optimum distribution for open propellers of arbitrary bladenumber and for any advance coefficient. The applicability of this finite element model to ducted propeller theory is explored. ESA

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N90-25117# General Engineering and Systems Analysis Co., Inc., Silver Spring, MD.

DEVELOPMENT OF A MICROCOMPUTER BASED SOFTWARE SYSTEM FOR USE IN CREWMEMBER EJECTION ANALYSIS Final Report, Feb. - Aug. 1989

Nagarajan Rangarajan 18 Aug. 1989 10 p
(Contract F33615-88-C-0544; AF Proj. 7231)
(AD-A220398; AAMRL-SR-89-501) Avail: NTIS HC A02/MF A01 CSCL 12/5

A prototype of DYNAMAN, which is an implementation of the Articulated Total Body (ATB) Model on PCs, was developed. DYNAMAN is an interactive software which can be used to analyze the dynamics of vehicle occupants and crewmember ejection problems. It is menu driven and is comprised of the preprocessor, the simulation module and the postprocessor. DYNAMAN will run on Intel 80286 based machines with appropriate math coprocessors. The preprocessor allows the analyst to set up, interactively, the input data set for the simulation module. The simulation module accepts input data sets created by the preprocessor and standard ATB-IV.O input data sets and produces picture, plot and print output files. The simulation module also calculates common injury measures such as the Chest Severity Index (CSI), Head Severity Index (HSI), and Head Injury Criteria (HIC). The postprocessor can be used to examine the motion of the vehicle occupant, and to obtain plots of various dynamic variables or to view them as tables. GRA

N90-25118 Department of the Navy, Washington, DC.

YAW FIN DEPLOYMENT APPARATUS FOR EJECTION SEAT Patent

Anthony T. Tran, inventor (to Navy), Chi R. Tung, inventor (to Navy), and Peter W. Yost, inventor (to Navy) 20 Feb. 1990 7 p Filed 5 Jul. 1988 Supersedes AD-D014148
(AD-D014512; US-Patent-4,901,951; US-Patent-Appl-SN-215139; US-Patent-Class-244-122) Avail: US Patent and Trademark Office CSCL 01/3

A yaw fin deployment apparatus provides a continuous deployment force to the fin during the entire range of deployment. A shaft, a movable sleeve bearing for riding along the shaft, a strut connected between the sleeve bearing and the fin, and a lanyard for continuously pulling the sleeve bearing along the shaft are provided. The momentum created when the ejection seat separates from the aircraft is transmitted to the lanyard, to the sleeve bearing, and to the strut for deploying the fin. A pulley is attached to the seat and is located near the aft end of the shaft and guides the lanyard to assure that the actuation force exerted on the sleeve bearing is in a direction parallel to the axis of the shaft. When the fin is fully deployed, the lanyard separates from the sleeve bearing through a split ring at the bottom of the sleeve bearing. A primary spring-loaded latch located at the aft end of the shaft locks the fin in a fully deployed position. GRA

N90-25119# Dayton Univ., OH.

STUDY OF THE ENGINE BIRD INGESTION EXPERIENCE OF THE BOEING 737 AIRCRAFT (OCTOBER 1986 TO SEPTEMBER 1988) Interim Report

Peter Hovey and Donald A. Skinn May 1990 148 p Prepared in cooperation with Federal Aviation Administration, Atlantic City, NJ
(Contract DTFA03-88-C-00024)
(DOT/FAA/CT-89/29; UDR-TR-89-65) Avail: NTIS HC A07/MF A01

The Federal Aviation Administration (FAA) Technical Center initiated a study in October 1986 to determine the numbers, sizes, and types of birds which are being ingested into medium and large inlet area turbofan engines and to determine what damage,

if any, results. Bird ingestion data are being collected for the Boeing 737 model aircraft which uses either the Pratt and Whitney JT8D medium inlet area turbofan engine or the CFM International CFM56 large inlet area turbofan engine. The first 2 years of data collection for the 3-year study are analyzed. Author

N90-25120*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
VIDEO PHOTOGRAPHIC CONSIDERATIONS FOR MEASURING THE PROXIMITY OF A PROBE AIRCRAFT WITH A SMOKE SEEDED TRAILING VORTEX
Brooks A. Childers and Walter L. Snow Jun. 1990 24 p
(NASA-TM-102691; NAS 1.15:102691) Avail: NTIS HC A03/MF A01 CSCL 01C

Considerations for acquiring and analyzing 30 Hz video frames from charge coupled device (CCD) cameras mounted in the wing tips of a Beech T-34 aircraft are described. Particular attention is given to the characterization and correction of optical distortions inherent in the data. Author

N90-25121*# Research Triangle Inst., Research Triangle Park, NC.
USERS GUIDE FOR AN AIRBORNE WINDSHEAR DOPPLER RADAR SIMULATION (AWDRS) PROGRAM Final Report
Charles L. Britt Jun. 1990 92 p
(Contract NAS1-17639)
(NASA-CR-182025; NAS 1.26:182025; RTI/3042/18-01F; DOT/FAA/DS-90/7) Avail: NTIS HC A05/MF A01 CSCL 01C

A description is provided of the Airborne Windshear Doppler Radar Simulation (AWDRS) program developed for NASA-Langley by the Research Triangle Institute. The radar simulation program is a comprehensive calculation of the signal characteristics and expected outputs of an airborne coherent pulsed Doppler radar system viewing a low level microburst along or near the approach path of the aircraft. The detailed nature of the simulation permits the quick evaluation of proposed trade-offs in radar system parameters and the evaluation of the performance of proposed configurations in various microburst/clutter environments. The simulation also provides a test bed for various proposed signal processing techniques for minimizing the effects of noise, phase jitter, and ground clutter and maximizing the useful information derived for avoidance of microburst windshear by aircraft.
Author

N90-25089# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (Germany, F.R.). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
SIMULATION OF TRANSPORT AEROPLANES [SIMULATION VON TRANSPORTFLUGZEUGEN]
Robert Luckner *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 115-122 In GERMAN Presented at ASIM-Arbeitskreis-Treffen Simulation Technischer Systeme, Stuttgart, Fed. Republic of Germany, 2-3 Mar. 1989 (For primary document see N90-25075 19-01)
(MBB-UT-007/89-PUB) Avail: NTIS HC A15/MF A02

N90-25103# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
DEVELOPMENT AND TEST OF SOFTWARE BY SAFETY CRITICAL AIRCRAFT SYSTEMS [ENTWICKLUNG UND PRUEFUNG VON SOFTWARE BEI SICHERHEITSKRITISCHEN LUFTFAHRTSYSTEMEN]
In its Research and Development: Technical and Scientific Publications 1989 1989 p 319-324 In GERMAN Presented at Fachseminar Sicherheitstechnik am Beispiel des Schienenverkehrs: Entwicklung ins naechste Jahrtausend, Brunswick, Fed. Republic of Germany, 18-19 Oct. 1988 (For primary document see N90-25075 19-01)
(MBB-FE-363/S/PUB-384) Avail: NTIS HC A15/MF A02

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N90-25122# Technology Planning, Inc., Rockville, MD.
NATIONAL AIRSPACE SYSTEM (NAS) SOFTWARE LIFE CYCLE MANAGEMENT STUDY Final Report
Mar. 1990 109 p
(Contract DTOS59-88-C-00064)
(AD-A221180; DOT/FAA/SE-90/1; DOT/FAA/CT-TN90/01)
Avail: NTIS HC A06/MF A01 CSCL 12/5

In implementing FAA-STD-026 (based on DOD-STD-216 7A) for acquiring NAS software and adopting the Ada Programming Language as the single high order language for NAS, several issues were raised pertaining to the differences in software development, testing, and maintenance practices between the NAS acquisition and operations support organizations. Some of the dificiences are identified and documented with respect to the existing process and guidelines used to acquire and maintain NAS software and recommends an action plan to address the identified deficiencies. In addition, it presents an overview (list of products and activities) of the NAS System Life Cycle management process within the context of a major systems acquisition, as described by FAA Orders 18100.8. The process is applicable to non-major systems as well. GRA

N90-25123# Federal Aviation Administration, Atlantic City, NJ.
REPLICATION OF NASPAC DALLAS/FORT WORTH STUDY
Douglas Baart, Anny Cheung, Joseph Richie, and Arthur Pomerantz (Computer Technology Associates, Inc., Lanham, MD.) Jul. 1990 27 p
(Grant F2006E)
(DOT/FAA/CT-TN90/26) Avail: NTIS HC A03/MF A01

A simulation study conducted at the Technical Center using the National Airspace System Performance Analysis Capability (NASPAC) is described. The simulation was an attempt to reproduce a study by the MITRE Corporation which examined the effects of the Dallas/Fort Worth (D/FW) Metroplex Plan on NAS delays and throughput. The results closely approximated the results found in the earlier simulation. Author

N90-25124# Norwegian Defence Research Establishment, Kjeller.
OBSERVATION OF SHIP MOVEMENT BY AEROPLANE
Borre Sorensen 12 Jan. 1990 195 p In NORWEGIAN; ENGLISH summary
(FFI-90/7001; ISSN-0802-2437; ETN-90-97110) Avail: NTIS HC A09/MF A01

The theory of Kalman filter is presented. The system and filter models for the specific problem, are discussed. Different Kalman filters, single and parallel, are designed. Implementation gives useful information about error propagation. How parallel Kalman filters affect the error propagation is indicated. ESA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*For land transportation vehicles see *85 Urban Technology and Transportation.*

N90-25125# Naval Postgraduate School, Monterey, CA.
AN APPROACH FOR DESIGN AND ANALYSIS OF COMPOSITE

ROTOR BLADES M.S. Thesis
Geraldo A. MacedoMoura Sep. 1989 87 p
(AD-A219257) Avail: NTIS HC A05/MF A01 CSCL 01/3

The advent of tilt rotor technology asks for rotors that have different twist and RPM requirements in hover and in forward flight to optimize for operational conditions. In order to get an assessment of the capabilities to fulfill these requirements this report presents a mapping of twist angle variation as a function of RPM and laminate orientation. The basic laminate for the six models as well the D-shape spar that represents the structurally active part of the blade is assumed to be constant. This six layer cross ply laminate is chosen as it provides the necessary extension-twist coupling without a hygrothermally induced twist that is highly undesireable. The couplings and trends in the models are visualized in carpet plots, one for each model, in an attempt to establish a method to answer the basic question of the magnitude of twist angle available due to a particular geometry, material and load system. GRA

N90-25126*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
TIME-OPTIMAL AIRCRAFT PURSUIT-EVASION WITH A WEAPON ENVELOPE CONSTRAINT Final Report
P. K. A. Menon Jun. 1990 24 p Presented at the American Control Conference, San Diego, CA, 23-25 May 1990
(Contract NCC2-506)
(NASA-CR-186640; NAS 1.26:186640) Avail: NTIS HC A03/MF A01 CSCL 01C

The optimal pursuit-evasion problem between two aircraft including a realistic weapon envelope is analyzed using differential game theory. Six order nonlinear point mass vehicle models are employed and the inclusion of an arbitrary weapon envelope geometry is allowed. The performance index is a linear combination of flight time and the square of the vehicle acceleration. Closed form solution to this high-order differential game is then obtained using feedback linearization. The solution is in the form of a feedback guidance law together with a quartic polynomial for time-to-go. Due to its modest computational requirements, this nonlinear guidance law is useful for on-board real-time implementation. Author

N90-25127*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
THE STEALTH BIPLANE: A PROPOSAL IN RESPONSE TO A LOW REYNOLDS NUMBER STATION KEEPING MISSION Final Design Proposal
Timothy E. Walsh, Kevin T. Flynn, Steven Donovan, Chris Paul, Harold Pangilinan, John Padgett, and Daniel Twomey May 1990 100 p
(Contract NASw-4435)
(NASA-CR-186680; NAS 1.26:186680) Avail: NTIS HC A05/MF A01 CSCL 01C

The Stealth Biplane is conceived and constructed to serve as a remotely piloted vehicle designed to navigate a low-level figure-eight course at a target Reynolds number of 100,000. This flight vehicle will combine the latest in lightweight radio controlled hardware in conjunction with current low Reynolds number aerodynamic research to demonstrate feasible operation in a variety of applications. These potential low Reynolds number applications include high altitude atmospheric sampling, search and rescue, and even law enforcement. Design specs and fabrication technique are discussed. Author

N90-25128*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
PROJECT DAWDLER: A PROPOSAL IN RESPONSE TO A LOW REYNOLDS NUMBER STATION KEEPING MISSION Final Design Proposal
Rich Bartilotti, Jill Coakley, Warren Golla, Glenn Scamman, Hoa T. Tran, and Chris Trippel May 1990 81 p
(Contract NASw-4435)
(NASA-CR-186668; NAS 1.26:186668) Avail: NTIS HC A05/MF A01 CSCL 01C

In direct response to Request for Proposals: Flight at very low Reynolds numbers - a station keeping mission, the members of Design Squad E present Project Dawdler: a remotely-piloted airplane supported by an independently controlled take-off cart. A brief introduction to Project Dawdler's overall mission and design, is given. The Dawdler is a remotely-piloted airplane designed to fly in an environmentally-controlled closed course at a Reynolds number of 10(exp 5) and at a cruise velocity of 25 ft/s. The two primary goals were to minimize the flight Reynolds number and to maximize the loiter time. With this in mind, the general design of the airplane was guided by the belief that a relatively light aircraft producing a fairly large amount of lift would be the best approach. For this reason the Dawdler utilizes a canard rather than a conventional tail for longitudinal control, primarily because the canard contributes a positive lift component. The Dawdler also has a single vertical tail mounted behind the wing for lateral stability, half of which is used as a rudder for yaw control. Due to the fact that the power required to take-off and climb to altitude is much greater than that required for cruise flight and simple turning maneuvers, it was decided that a take-off cart be used. Based on the current design, there are two unknowns which could possibly threaten the success of Project Dawdler. First, the effect of the fully-movable canard with its large appropriation of total lift on the performance of the plane, and secondly, the ability of the take-off procedure to go as planned are examined. These are questions which can only be answered by a prototype. Author

N90-25129*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
THE PENGUIN: A LOW REYNOLDS NUMBER POWERED GLIDER FOR STATION KEEPING MISSIONS Final Design Proposal
J. K. Costello, D. W. Greene, T. T. Lee, P. T. Matier, T. R. McCarthy, R. J. McGuire, and M. J. Schuette May 1990 92 p Sponsored in part by Boeing Commercial Airplane Co.
(Contract NASw-4435)
(NASA-CR-186667; NAS 1.26:186667) Avail: NTIS HC A05/MF A01 CSCL 01C

The Penguin is a low Reynolds number (approx. 100,000) remotely piloted vehicle (RPV). It was designed to fly three laps indoors around two pylons in a figure-eight course while maximizing loiter time. The Penguin's low Reynolds number mission is an important one currently being studied for possible future flights in the atmospheres of other planets and for specialized military missions. Although the Penguin's mission seemed quite simple at first, the challenges of such low Reynolds number flight have proven to be quite unique. In addition to the constraint of low Reynolds number flight, the aircraft had to be robust in its control, highly durable, and it had to carry a small instrument package. The Penguin's flight plan, concept, performance, aerodynamic design, weight estimation, structural design, propulsion, stability and control, and cost estimate is detailed. Author

N90-25130*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
DRAG-n-FLY: A PROPOSAL IN RESPONSE TO A LOW REYNOLDS NUMBER STATION KEEPING MISSION Final Design Proposal
Mark Foohey, John Niehaus, Jenny Neumann, Pat Deviny, Jerry Zurovchak, Joey Brenner, and Peter Gendron May 1990 123 p Sponsored in part by Boeing Commercial Airplane Co.
(Contract NASw-4435)
(NASA-CR-186666; NAS 1.26:186666) Avail: NTIS HC A06/MF A01 CSCL 01C

The Drag-n-Fly is a remotely piloted, low Reynolds number vehicle. It was designed to maintain level controlled flight and fly a closed course at flight speeds corresponding to Reynolds numbers of less than 2 x 10(exp 5) and as close to 1 x 10(exp 5) as possible. The success of the mission will be associated with achieving the lowest mean chord Reynolds number possible and maximizing loiter time on the course. The flight plan for the Drag-n-Fly calls for the vehicle to ascent to a cruise altitude of 25 ft. The airfoil selected for the Drag-n-Fly is a Spica chosen for

its high lift coefficient at low Reynolds number. The propulsion system for the Drag-n-Fly consists of a 10 inch diameter propeller mounted on the front of the vehicle. Structural support for the Drag-n-Fly comes from four box beams running the length of the fuselage. The tail and horizontal stabilizers are located far aft of the lifting surface in order to assure proper static stability. The present design for the Drag-n-Fly will meet the criteria for the present mission. Author

N90-25131*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
THE FX/90: A PROPOSAL IN RESPONSE TO A LOW REYNOLDS NUMBER STATION KEEPING MISSION Final Design Proposal
David Wirthman, Julie Palmer, Aaron Gleixner, Scott Russell, Tom Nevala, and Mark Nosek May 1990 99 p
(Contract NASw-4435)
(NASA-CR-186665; NAS 1.26:186665) Avail: NTIS HC A05/MF A01 CSCL 01C

The FX/90 is a remotely piloted vehicle designed to fly at Reynolds numbers below 2 x 10 to the 5th power. Several applications exist for this type of flight, such as low altitude flight of very small aircraft. The design presented here allows investigation into the unique problems involved in low Reynolds number flight, which will, in turn, further understanding of this flight regime. The aircraft will operate in a steady flight environment, free from significant atmospheric turbulence and weather effects. The F-90 has a 39 in. fuselage which is constructed of balsa and plywood. The landing gear for the aircraft is a detachable carriage on which the aircraft rests. The aerodynamic planform is a rectangular wing (no taper or sweep) with a chord of 9 in., a wingspan of 72 in., and is constructed entirely out of styrofoam. The propulsion system is a puller configuration mounted on the front of the fuselage. It consists of an Astro 05 engine and a 10-6 two bladed propeller. Control of the aircraft is accomplished through the use of two movable control surfaces: elevators for pitch control, and a rudder for yaw control. The aircraft is soundly constructed, highly maneuverable, and adequately powered. Furthermore, the investigation into alternative technologies, most notably the styrofoam wing and the detachable landing gear, holds promise to improve the performance of the aircraft. Author

N90-25132*# Auburn Univ., AL.
DESIGN OF A LOW COST SHORT TAKEOFF-VERTICAL LANDING EXPORT FIGHTER/ATTACK AIRCRAFT
Anne Belcher, Dan Bodeker, III, Steve Miu, Laura Petro, Cary Taylor Senf, and Donald Woeltjen Jun. 1990 91 p
(Contract NASw-4435)
(NASA-CR-186658; NAS 1.26:186658) Avail: NTIS HC A05/MF A01 CSCL 01C

The design of a supersonic short takeoff and vertical landing (STOVL) aircraft is presented that is suitable for export. An advanced four poster, low bypass turbofan engine is to be used for propulsion. Preliminary aerodynamic analysis is presented covering a determination of CD versus CL, CD versus Mach number, as well as best cruise Mach number and altitude. Component locations are presented and center of gravity determined. Cost minimization is achieved through the use of developed subsystems and standard fabrication techniques using nonexotic materials. Conclusions regarding the viability of the STOVL design are presented. Author

N90-25133# Wichita State Univ., KS. Inst. for Aviation Research.
ELEVATOR TAB ASSEMBLY PRODUCIBILITY STUDY
Wayne Becker, Mark Wadsworth, and Darrin Teeter Jul. 1989 86 p
(IAR-89-16) Avail: NTIS HC A05/MF A01

In November 1988, Beech Aircraft Corp. requested a producibility study of resin transfer molding (RTM) for aircraft structures. Specifically, the technology was to be developed which would enable Beech to manufacture a composite elevator trim tab more cost effectively and with more structural efficiency than is presently possible. Appendix C contains the proposal and previous designs that have been made. The results of this research are summarized. Author

N90-25134*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
EVALUATION OF VARIOUS THRUST CALCULATION TECHNIQUES ON AN F404 ENGINE
Ronald J. Ray Apr. 1990 31 p
(NASA-TP-3001; H-1505; NAS 1.60:3001) Avail: NTIS HC A03/MF A01 CSCL 21E

In support of performance testing of the X-29A aircraft at the NASA-Ames, various thrust calculation techniques were developed and evaluated for use on the F404-GE-400 engine. The engine was thrust calibrated at NASA-Lewis. Results from these tests were used to correct the manufacturer's in-flight thrust program to more accurately calculate thrust for the specific test engine. Data from these tests were also used to develop an independent, simplified thrust calculation technique for real-time thrust calculation. Comparisons were also made to thrust values predicted by the engine specification model. Results indicate uninstalled gross thrust accuracies on the order of 1 to 4 percent for the various in-flight thrust methods. The various thrust calculations are described and their usage, uncertainty, and measured accuracies are explained. In addition, the advantages of a real-time thrust algorithm for flight test use and the importance of an accurate thrust calculation to the aircraft performance analysis are described. Finally, actual data obtained from flight test are presented. Author

N90-25135*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
FLUTTER CLEARANCE OF THE F-14A VARIABLE-SWEEP TRANSITION FLIGHT EXPERIMENT AIRPLANE, PHASE 2
Lawrence C. Freudinger and Michael W. Kehoe Jul. 1990 43 p
(NASA-TM-101717; H-1544; NAS 1.15:101717) Avail: NTIS HC A03/MF A01 CSCL 01C

An F-14A aircraft was modified for use as the test-bed aircraft for the variable-sweep transition flight experiment (VSTFE) program. The VSTFE program was a laminar flow research program designed to measure the effects of wing sweep on laminar flow. The airplane was modified by adding an upper surface foam and fiberglass glove to the right wing. An existing left wing glove had been added for the previous phase of the program. Ground vibration and flight flutter testing were accomplished to verify the absence of aeroelastic instabilities within a flight envelope of Mach 0.9 or 450 knots, calibrated airspeed, whichever was less. Flight test data indicated satisfactory damping levels and trends for the elastic structural modes of the airplane. Ground vibration test data are presented along with in-flight frequency and damping estimates, time histories and power spectral densities of in-flight sensors, and pressure distribution data. Author

N90-25136# Federal Aviation Administration, Atlantic City, NJ.
THE EFFECT OF AIRCRAFT SIZE ON CABIN FLOOR DYNAMIC PULSES Final Report, Oct. 1987 - Dec. 1989
Gil Wittlin (Lockheed Aeronautical Systems Co., Burbank, CA.) and Larry Neri Mar. 1990 60 p
(Contract DTFA03-84-C-00004)
(DOT/FAA/CT-88/15; LR-31426) Avail: NTIS HC A04/MF A01

Size scaling trends are reviewed and updated. An investigation is presented into the effect that airplane size has on dynamic floor pulses generated within the cabin during a crash impact event. Included is: (1) A review of narrow-body and wide-body section test results and supporting analytical model results; (2) The utilization of the Controlled Impact Demonstration (CID) validated KRASH model to perform additional parametric studies; (3) Defined relationships between parameters which influence aircraft structure dynamic response; and (4) Developed airplane preliminary size effect trend curves for floor dynamic pulses in terms of triangular pulse magnitudes, velocity changes and pulse

duration. A simple approximate expression relating aircraft fuselage crush energy dissipation and kinetic energy are utilized to generate a set of triangular pulse velocity - crush distance - peak acceleration curves. Estimated effective crush distances for various classes of airplane sizes or categories and available acceleration, velocity and crush data are plotted. Plots for vertical-direction and longitudinal-direction are presented. Author

N90-25137# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Dienstleistungsbereich.
CALCULATION OF THICK WALL FIBER BINDERS FOR ROTOR COMPONENTS OF MODERN HELICOPTERS [BERECHNUNG DICKWANDIGER FASERVERBUNDE FUER ROTORKOMPONENTEN MODERNER HUBSCHRAUBER]
O. Haider 1989 22 p In GERMAN Presented at DGLR-Jahrestagung-1989, Hamburg, Fed. Republic of Germany, 2-4 Oct. 1989
(MBB-UD-554/84-PUB; DGLR-89-127; ETN-90-96779) Avail: NTIS HC A03/MF A01

The fiber binder structure is calculated by the finite element method to obtain the characteristic values of dimensional elasticity. An extension of the laminate theory is made to determine complete elasticity constants. It is then possible to gather several laminate layers in a material. It is unnecessary to idealize separately every layer, which reduces greatly the calculation time. A good shape of elements of a helicopter rotor was found with this method. ESA

N90-25092# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
SCENARIO 2000 [SZENARIO 2000]
Volker vonTein *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 161-170 In GERMAN Presented at Hubschrauberforum, Bueckeburg, Fed. Republic of Germany, 9-10 May 1989 (For primary document see N90-25075 19-01)
(MBB-UD-500/89-PUB) Avail: NTIS HC A15/MF A02

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N90-25138# National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.
AN ACCURATE NUMERICAL TECHNIQUE FOR DETERMINING FLIGHT TEST RATE GYROSCOPE BIASES PRIOR TO TAKEOFF
G. M. Beauchamp Mar. 1989 5 p
(AD-A220987; NAE-AN-39; NRC-30116) Avail: NTIS HC A01/MF A01 CSCL 01/4

Rate gyroscope biases play an important role in flight tests requiring flight path reconstruction, a method often used in aircraft parameter estimation. The biases can drift with time, be affected by system power up and, ideally, should be calibrated before each flight to maintain optimum performance. A numerical method is detailed to determine the biases of high quality flight test rate gyroscopes immediately prior to a flight. The accuracy of the method is such that the earth rate is clearly sensed and accounted for, a variable rarely considered in flight testing. The method requires minimal time and no calibration hardware. Author

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N90-25139# Rolls-Royce Ltd., Derby (England).
FROM 1959-1989: 30 YEARS OF SERVICE EXPERIENCE WITH RAMJETS
D. R. Lane 12 Mar. 1989 23 p Presented at RAes Conference, London, England, 12 Mar. 1989
(PNR90677; ETN-90-97158) Copyright Avail: NTIS HC A03/MF A01

Precautions taken during design of ramjets to achieve reliability and a low level of maintenance effort are described. In the third generation, design progressed to the establishment of wooden round status for a factory filled liquid fuel ramjet which requires no maintenance during a life of 15 years. The reliability of the ramjet propulsion system in many practice firings of service maintained missiles by service crews is discussed and shown to compare will that of solid fuel rocket systems. ESA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N90-25140# Lockheed Aeronautical Systems Co., Burbank, CA.
MODELING FLEXIBLE AIRCRAFT FOR FLIGHT CONTROL DESIGN Interim Report, Sep. 1986 - Mar. 1988
E. C. Bekir, W. J. Davis, A. Goforth, H. Hassig, E. J. Horowitz, R. N. Moon, and G. A. Watts Jan. 1989 433 p
(Contract F33615-86-C-3625; AF Proj. 2403)
(AD-A219123; AFWAL-TR-88-3089) Avail: NTIS HC A19/MF A03 CSCL 01/3

Trends to lower structural fraction of aircraft increase flexibility effects. Higher bandwidth control systems combined with these more flexible structures cause more aeroservoelastic interactions. Active, closed loop control systems allow greater flexibility. To take advantage of this design possibility, an integrated ASE model is needed for conceptual and preliminary design stages of aircraft. The equations of motion of a flexible aircraft from first principles are defined to aid future discussions between experts in the specialties which make up ASE: aerodynamics, controls, and structures. The development of the equations is documented, and conditions are stated under which the assumptions approximations are accurate. Five sections are given on different technical areas along with a summary: (1) Linearization of flexible aircraft hybrid-coordinate dynamic equations and inclusion of aerodynamic and gravitational loads; (2) Derivation of equations of motion and stability derivatives for a flexible aircraft vehicle; (3) Aerodynamics for aeroservoelasticity; (4) Model-order reduction for linear systems; and (5) Hydraulic actuator eqautions for aeroservoelastic modeling. Author

N90-25141*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
GROUND-SIMULATION INVESTIGATIONS OF VTOL AIRWORTHINESS CRITERIA FOR TERMINAL-AREA OPERATIONS
J. V. Lebacqz, W. A. Decker, T. S. Alderete, B. C. Scott, P. J. G. Harper, and W. W. Chung (SYRE Corp., Moffett Field, CA.) May 1990 18 p Presented at the Royal Aeronautical Society Meeting: Progress in Helicopter and V/STOL Aircraft Simulation, London,

England, 1-2 May 1990
(NASA-TM-102810; A-90129; NAS 1.15:102810) Avail: NTIS HC A03/MF A01 CSCL 01C

Several ground-based simulation experiments undertaken to investigate concerns related to tilt-rotor aircraft airworthiness were conducted. The experiments were conducted on the National Aeronautics and Space Administration (NASA) Ames Research Center's Vertical Motion Simulator, which permits simulation of a wide variety of aircraft with a high degree of fidelity of motion cueing. Variations in conversion/deceleration profile, type of augmentation or automation, level of display assistance, and meteorological conditions were considered in the course of the experiments. Certification pilots from the Federal Aviation Administration (FAA) and the Civil Aviation Authority (CAA) participated, in addition to NASA research pilots. The setup of these experiments on the simulator is summarized, and some of the results highlighted. Author

N90-25142*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
EFFECTS OF SIMPLIFYING ASSUMPTIONS ON OPTIMAL TRAJECTORY ESTIMATION FOR A HIGH-PERFORMANCE AIRCRAFT
Lura E. Kern, Steve D. Belle (PRC Systems Services Co., Edwards, CA.), and Eugene L. Duke Apr. 1990 27 p Presented at the AIAA Atmospheric Flight Mechanics Conference, Boston MA, 14-16 Aug. 1989
(NASA-TM-101721; H-1597; NAS 1.15:101721) Avail: NTIS HC A03/MF A01 CSCL 01C

When analyzing the performance of an aircraft, certain simplifying assumptions, which decrease the complexity of the problem, can often be made. The degree of accuracy required in the solution may determine the extent to which these simplifying assumptions are incorporated. A complex model may yield more accurate results if it describes the real situation more thoroughly. However, a complex model usually involves more computation time, makes the analysis more difficult, and often requires more information to do the analysis. Therefore, to choose the simplifying assumptions intelligently, it is important to know what effects the assumptions may have on the calculated performance of a vehicle. Several simplifying assumptions are examined, the effects of simplified models to those of the more complex ones are compared, and conclusions are drawn about the impact of these assumptions on flight envelope generation and optimal trajectory calculation. Models which affect an aircraft are analyzed, but the implications of simplifying the model of the aircraft itself are not studied. The examples are atmospheric models, gravitational models, different models for equations of motion, and constraint conditions. Author

N90-25143*# Sikorsky Aircraft, Stratford, CT.
GROUND SHAKE TEST OF THE UH-60A HELICOPTER AIRFRAME AND COMPARISON WITH NASTRAN FINITE ELEMENT MODEL PREDICTIONS Final Report
G. R. Howland, J. A. Durno, and W. J. Twomey Mar. 1990 236 p
(Contract NAS1-17499)
(NASA-CR-181993; NAS 1.26:181993) Avail: NTIS HC A11/MF A02 CSCL 01C

Sikorsky Aircraft, together with the other major helicopter airframe manufacturers, is engaged in a study to improve the use of finite element analysis to predict the dynamic behavior of helicopter airframes, under a rotorcraft structural dynamics program called DAMVIBS (Design Analysis Methods for VIBrationS), sponsored by the NASA-Langley. The test plan and test results are presented for a shake test of the UH-60A BLACK HAWK helicopter. A comparison is also presented of test results with results obtained from analysis using a NASTRAN finite element model. Author

N90-25144*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
FLIGHT-TESTING OF THE SELF-REPAIRING FLIGHT CONTROL SYSTEM USING THE F-15 HIGHLY INTEGRATED DIGITAL ELECTRONIC CONTROL FLIGHT RESEARCH FACILITY
James F. Stewart and Thomas L. Shuck Aug. 1990 17 p Prsented at the AIAA/SFTE/DGLR/SETP 5th Biannual Flight Test Conference, Ontario, CA, 21-24 May 1990 Previously announced in IAA as A90-34149
(NASA-TM-101725; H-1635; NAS 1.15:101725; AIAA-90-1321) Avail: NTIS HC A03/MF A01 CSCL 01C

Flight tests conducted with the self-repairing flight control system (SRFCS) installed on the NASA F-15 highly integrated digital electronic control aircraft are described. The development leading to the current SRFCS configuration is highlighted. Key objectives of the program are outlined: (1) to flight-evaluate a control reconfiguration strategy with three types of control surface failure; (2) to evaluate a cockpit display that will inform the pilot of the maneuvering capacity of the damage aircraft; and (3) to flight-evaluate the onboard expert system maintenance diagnostics process using representative faults set to occur only under maneuvering conditions. Preliminary flight results addressing the operation of the overall system, as well as the individual technologies, are included. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N90-25145# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
AN OBJECT-ORIENTED SOLUTION EXAMPLE: A FLIGHT SIMULATOR ELECTRICAL SYSTEM Final Report
Kenneth J. Lee and Michael S. Rissman Feb. 1989 174 p
(Contract F19628-85-C-0003)
(AD-A219190; CMU/SEI-89-TR-5; ESD-TR-89-5) Avail: NTIS HC A08/MF A01 CSCL 14/2

An implementation of a subset of an aircraft flight simulator electrical system is described. It is a result of work on the Ada Simulator Validation Program (ASVP) carried out by members of the technical staff (MTS) at the Software Engineering Institute. The MTS developed a paradigm for describing and implementing flight simulator systems in general. The paradigm is a model for implementing systems of objects. The objects are described in a form of design specification called an object diagram. A full implementation of a system is described: Package specifications and bodies. The intent is to provide an example; the code is functional, but there is no assurance of robustness. Author

N90-25146# Minister of State for Research and Technology, Jakarta (Indonesia).
PROJECT TTA-79: SUMMARY PROJECT REPORT
1987 26 p Prepared in cooperation with Ministry of Foreign Affairs, The Hague, Netherlands; Agency for the Assessment and Application of Technology, Indonesia; and NAL, Amsterdam, Netherlands Original contains color illustrations
(ETN-90-96773) Avail: NTIS HC A03/MF A01

Main aspects of the Technical Assistance Project (TTA-79) carried out by the governments of Indonesia and the Netherlands, between 1 Oct. 1987 to 20 Aug. 1981 are summarized. Objectives, institutional framework, and project organization, management and planning are detailed. Successful conclusions are reported on these and the recognition of the necessity for a follow-on project is made. ESA

N90-25147# CBI Na-Con, Oak Brook, IL.
ROME AIR DEVELOPMENT CENTER CRYO TEST FACILITY Final Technical Report, Jun. 1987 - Jun. 1989
Warren Carpenter Feb. 1990 19 p
(Contract F30602-87-C-0058)
(AD-A220067; RADC-TR-89-348) Avail: NTIS HC A03/MF A01 CSCL 20/6

The Cryo Test Facility was specified and designed to determine the surface figure of large optics, up to 2-meters, at temperatures from ambient to 100 K. The project was successfully completed. All performance specifications were met or exceeded. The facility was well designed and constructed. GRA

N90-25148 Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
EVALUATION OF NONLINEAR MOTION-DRIVE ALGORITHMS FOR FLIGHT SIMULATORS Thesis
Jeff Kirdeikis Jun. 1989 251 p
(UTIAS-TN-272; ISSN-0082-5263) Copyright Avail: Issuing Activity

The effects on the performance of the nonlinear adaptive algorithm of changing the form of the cost function and allowing the gain, frequency, and damping parameters of the translational motion filters to adapt were determined. A general form of the quadratic cost function of degree N, where N = 2, 4, 6, and a piecewise-linear cost function were developed. A range scaling algorithm which accounts for the variations in the motion envelope with simulator position of the synergistic motion base was also developed. The evaluation of the algorithms employed idealized test signals, prerecorded aircraft maneuver inputs and a piloted simulation using a B747 aircraft model on the six degree-of-freedom UTIAS Flight Research Simulator. The results of the evaluation for the adaptive algorithm indicate that gain adaption produces the most realistic motion cues and is more effective at limiting motion base displacements than the frequency and damping of the combined gain, frequency and damping parameter adaption. Increasing the degree of the cost function decreased the sensitivity of the adaptive parameters. The fourth degree cost function with gain adaption was considered the best algorithm by the evaluation pilot. The performance of the range scaling algorithm was promising in many aspects but during the piloted simulation some oscillations on the rotational channels were sensed by the pilot. Author

N90-25149*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TRENDS: THE AERONAUTICAL POST-TEST DATABASE MANAGEMENT SYSTEM
W. S. Bjorkman (Analytical Mechanics Associates, Inc., Mountain View, CA.) and M. J. Bondi Jan. 1990 130 p
(NASA-TM-101025; A-88225; NAS 1.15:101025) Avail: NTIS HC A07/MF A01 CSCL 14B

TRENDS, an engineering-test database operating system developed by NASA to support rotorcraft flight tests, is described. Capabilities and characteristics of the system are presented, with examples of its use in recalling and analyzing rotorcraft flight-test data from a TRENDS database. The importance of system user-friendliness in gaining users' acceptance is stressed, as is the importance of integrating supporting narrative data with numerical data in engineering-test databases. Considerations relevant to the creation and maintenance of flight-test database are discussed and TRENDS' solutions to database management problems are described. Requirements, constraints, and other considerations which led to the system's configuration are discussed and some of the lessons learned during TRENDS' development are presented. Potential applications of TRENDS to a wide range of aeronautical and other engineering tests are identified. Author

N90-25150# Federal Aviation Administration, Atlantic City, NJ.
TAXIWAY SIGN EFFECTIVENESS UNDER REDUCED VISIBILITY CONDITIONS
Paul H. Jones May 1990 23 p
(DOT/FAA/CT-TN90/20) Avail: NTIS HC A03/MF A01

An evaluation was conducted to determine whether any or all of the standard internally lighted taxiway guidance sign sizes, when located at the current recommended distance from the taxiway edge, provide adequate guidance in reduced visibility conditions. The L858R mandatory and L858Y informational types of taxiway guidance signs were used for the evaluation. The three standard sizes of each type of sign were set up at the maximum recommended distance from the taxiway edge. Tests were conducted at the intersection of taxiway B and runway 4-22 on the Atlanta City International Airport. Data were collected during periods of actual reduced visibility. Over 200 observations in visibilities between 400 to 1900 feet were collected. Typical low-speed taxi stopping distances were obtained through actual tests with a Boeing 727 aircraft. These stopping distance values were then compared to the actual recognition distances for the signs under low visibility conditions. From the data collected, all sizes of signs tested provided adequate guidance to allow a pilot to recognize the sign message and take appropriate actions when needed. Author

N90-25151*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH-TEMPERATURE TEST FACILITY AT THE NASA LEWIS ENGINE COMPONENTS RESEARCH LABORATORY
Renato O. Colantonio Jun. 1990 22 p Original contains color illustrations
(NASA-TM-103143; E-5495; NAS 1.15:103143) Avail: NTIS HC A03/MF A01; 1 functional color page CSCL 14B

The high temperature test facility (HTTF) at NASA-Lewis Engine Components Research Laboratory (ECRL) is presently used to evaluate the survivability of aerospace materials and the effectiveness of new sensing instrumentation in a realistic afterburner environment. The HTTF has also been used for advanced heat transfer studies on aerospace components. The research rig uses pressurized air which is heated with two combustors to simulate high temperature flow conditions for test specimens. Maximum airflow is 31 pps. The HTTF is pressure rated for up to 150 psig. Combustors are used to regulate test specimen temperatures up to 2500 F. Generic test sections are available to house test plates and advanced instrumentation. Customized test sections can be fabricated for programs requiring specialized features and functions. The high temperature test facility provides government and industry with a facility for testing aerospace components. Its operation and capabilities are described. Author

N90-25152# European Space Agency, Paris (France).
THE LOW-SPEED WIND TUNNEL AT DFVLR IN BRUNSWICK (STATUS 1988)
Gerhard Kausche, Horst Otto, Dietmar Christ, and Ruediger Siebert (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) May 1990 108 p Transl. into ENGLISH from Der Niedergeschwindigkeits-Windkanal der DFVLR in Braunschweig (Stand 1988) (Brunswick, Fed. Republic of Germany, DFVLR), Sep. 1988 96 p Original language document was announced as N89-22619
(ESA-TT-1163; DFVLR-Mitt-88-25; ETN-90-97077) Avail: NTIS HC A06/MF A01

Information for users of the Low-Speed Wind Tunnel (NWB) of DFVLR at Brunswick (Fed. Republic of Germany) is presented. This wind tunnel is a facility with a closed return circuit comprising an open and a closed test section, the cross-section being 3.25 m by 2.80 m. The maximum achievable velocities are 90 m/s in the closed test section and 75 m/s in the open one. A variety of different experiments can be done in the NWB. The information required by customers for the preliminary planning of test programs and for the preliminary layout of models for intended tests is presented. ESA

N90-25153# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
LECTURE NOTES ON FLIGHT SIMULATION TECHNIQUES

M. Baarspul Aug. 1989 258 p
(LR-596; ETN-90-97165) Avail: NTIS HC A12/MF A02

The evolution of flight simulation techniques is reviewed and the main areas of flight simulator applications are addressed. The main components of a piloted flight simulator are described. Solutions to meet the high computer power required are elaborated. Available visual systems are described and characteristics of out-of-the-window visual simulation systems are discussed. Different types of motion systems (for example airline training and research) are described. The complete motion system, hardware and software, is discussed. Principles of mathematical modeling of aerodynamic, flight control, propulsion, landing gear and environmental characteristics are reviewed. An example of the identification of an aircraft mathematical model, based on flight and taxi tests, is presented. The application of ADA in realtime flight simulation is given. ESA

N90-25566*# University of Central Florida, Orlando.
AN INTELLIGENT SIMULATION TRAINING SYSTEM
John E. Biegel *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 579-584 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N90-25154*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A STUDY OF CONCEPT OPTIONS FOR THE EVOLUTION OF SPACE STATION FREEDOM
Herbert R. Kowitz, Karen D. Brender, William M. Cirillo, Lisa Collier, George G. Ganoe, Marston J. Gould, Martin Kaszubowski, George F. Lawrence, Charles P. Llewellyn, and Ray Reaux (Computer Technology Associates, Inc., Rockville, MD.) May 1990 77 p
(NASA-TM-102675; NAS 1.15:102675) Avail: NTIS HC A05/MF A01 CSCL 22A

Two conceptual evolution configurations for Space Station Freedom, a research and development configuration, and a transportation node configuration are described and analyzed. Results of pertinent analyses of mass properties, attitude control, microgravity, orbit lifetime, and reboost requirements are provided along with a description of these analyses. Also provided are brief descriptions of the elements and systems that comprise these conceptual configurations. Author

N90-25083# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensgruppe Raumfahrt.
MARS, AN AI-BASED MISSION ACTIVITIES AND RESOURCE SCHEDULER
Norbert Schielow, Friedrich Zapp, and Albrecht Kellner *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 53-62 Presented at ESTEC Workshop on Artificial Intelligence: Applications for Space Projects, Noordwijk, Netherlands, 15-17 Nov. 1988 (For primary document see N90-25075 19-01)
(MBB-0060/89-PUB) Avail: NTIS HC A15/MF A02

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N90-25155*# Texas Univ., Austin. Dept. of Mechanical Engineering.
DEVELOPMENT OF A COMPUTER MODEL TO PREDICT PLATFORM STATION KEEPING REQUIREMENTS IN THE GULF OF MEXICO USING REMOTE SENSING DATA
Bryan Barber, Laura Kahn, and David Wong 9 Apr. 1990 124 p Original contains color illustrations
(Contract NASw-4435)
(NASA-CR-186678; NAS 1.26:186678) Avail: NTIS HC A06/MF A01; 7 functional color pages CSCL 22A

Offshore operations such as oil drilling and radar monitoring require semisubmersible platforms to remain stationary at specific locations in the Gulf of Mexico. Ocean currents, wind, and waves in the Gulf of Mexico tend to move platforms away from their desired locations. A computer model was created to predict the station keeping requirements of a platform. The computer simulation uses remote sensing data from satellites and buoys as input. A background of the project, alternate approaches to the project, and the details of the simulation are presented. Author

N90-25156 Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (Germany, F.R.).
THEORETICAL PRINCIPLES OF THE FHP-GA TRAJECTORY CALCULATION PROGRAM
Hans G. Peters Oct. 1989 19 p In GERMAN; ENGLISH summary Sponsored by Bundesministers der Verteidigung
(FB-10-89; Lfd-291; ETN-90-96782) Avail: Forschungsinstitut fuer Hochfrequenzphysik, Wachtberg-Werthhoven, Fed. Republic of Germany

A modification of the Brouver-Lyddane theory is used to calculate the trajectories of artificial Earth satellites. The perturbations in the nonsingular elements of the modified theory were derived. The Delaunay elements from the Hamilton-Jacobi equation of the two body problem were used as well as the Poincare variables. A particular consideration was given to the accuracy in the excentricity calculation. Satellite positions can be estimated from the osculating elements obtained from the perturbation terms. ESA

N90-25157# Technische Univ., Delft (Netherlands). Orbital Mechanics Sections.
SATELLITE ORBIT DETERMINATION AND GRAVITY FIELD RECOVERY FROM SATELLITE-TO-SATELLITE TRACKING
K. F. Wakker, B. A. C. Ambrosius, and H. Leenman Jul. 1989 357 p
(LR-605; ETN-90-97171) Avail: NTIS HC A16/MF A02

Studies on satellite-to-satellite tracking (SST) with POPSAT (a geodetic satellite concept) and a ERS-class (Earth observation) satellite, a Satellite-to-Satellite Tracking (SST) gravity mission, and precise gravity field determination methods and mission requirements are reported. The first two studies primarily address the application of SST between the high altitude POPSAT and an ERS-class or GRM (Geopotential Research Mission) satellite to the orbit determination of the latter two satellites. Activities focussed on the determination of the tracking coverage of the lower altitude satellite by ground based tracking systems and by POPSAT, orbit determination error analysis and the determination of the surface forces acting on GRM. The third study surveys principles of SST, uncertainties of existing drag models, effects of direct luni-solar attraction and tides on orbit and the gravity gradient observable. Detailed ARISTOTELES (which replaced POPSAT) orbit determination error analyses were performed for various ground based tracking networks. ESA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N90-25158*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LOW THRUST ROCKET TEST FACILITY
Lynn A. Arrington (Sverdrup Technology, Inc., Cleveland, OH.) and Steven J. Schneider Jul. 1990 22 p Presented at the 26th

Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; sponsored in part by AIAA, SAE, ASME, and ASEE
(NASA-TM-103206; E-5571; NAS 1.15:103206; AIAA-90-2503)
Avail: NTIS HC A03/MF A01 CSCL 14B

A low thrust chemical rocket test facility has recently become operational at the NASA-Lewis. The new facility is used to conduct both long duration and performance tests at altitude over a thruster's operating envelope using hydrogen and oxygen gas for propellants. The facility provides experimental support for a broad range of objectives, including fundamental modeling of fluids and combustion phenomena, the evaluation of thruster components, and life testing of full rocket designs. The major mechanical and electrical systems are described along with aspects of the various optical diagnostics available in the test cell. The electrical and mechanical systems are designed for low down time between tests and low staffing requirements for test operations. Initial results are also presented which illustrate the various capabilities of the cell. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N90-25159*# Sverdrup Technology, Inc., Brook Park, OH.
ROCKET ENGINE FAILURE DETECTION USING SYSTEM IDENTIFICATION TECHIQUES Final Report
Claudia M. Meyer and June F. Zakrajsek Jun. 1990 18 p
Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-20 Jul. 1990; cosponsored by AIAA, SAE, ASME, and ASEE
(Contract NAS3-25266)
(NASA-CR-185259; E-5585; NAS 1.26:185259; AIAA-90-1993)
Avail: NTIS HC A03/MF A01 CSCL 22B

The theoretical foundation and application of two univariate failure detection algorithms to Space Shuttle Main Engine (SSME) test firing data is presented. Both algorithms were applied to data collected during steady state operation of the engine. One algorithm, the time series algorithm, is based on time series techniques and involves the computation of autoregressive models. Times series techniques have been previously applied to SSME data. The second algorithm is based on standard signal processing techniques. It consists of tracking the variations in the average signal power with time. The average signal power algorithm is a newly proposed SSME failure detection algorithm. Seven nominal test firings were used to develop failure indication thresholds for each algorithm. These thresholds were tested using four anomalous firings and one additional nominal firing. Both algorithms provided significantly earlier failure indication times than did the current redline limit system. Neither algorithm gave false failure indications for the nominal firing. The strengths and weaknesses of the two algorithms are discussed and compared. The average signal algorithm was found to have several advantages over the time series algorithm. Author

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N90-25160*# National Aeronautics and Space Administration, Washington, DC.
SPACE SHUTTLE AVIONICS SYSTEM
John F. Hanaway (Intermetrics, Inc., Houston, TX.) and Robert W. Moorehead 1989 75 p Original contains color illustrations
(Contract NAS9-17826)
(NASA-SP-504; S-579; NAS 1.21:504; LC-89-600316) Avail: NTIS HC A04/MF A01; also available SOD HC $8.50 as 033-000-01079-6; 5 functional color pages CSCL 22B

The Space Shuttle avionics system, which was conceived in the early 1970's and became operational in the 1980's represents a significant advancement of avionics system technology in the areas of systems and redundacy management, digital data base technology, flight software, flight control integration, digital fly-by-wire technology, crew display interface, and operational concepts. The origins and the evolution of the system are traced; the requirements, the constraints, and other factors which led to the final configuration are outlined; and the functional operation of the system is described. An overall system block diagram is included. Author

N90-25161*# Texas Univ., Austin. Dept. of Mechanical Engineering.
DESIGN OF A THERMAL AND MICROMETEORITE PROTECTION SYSTEM FOR AN UNMANNED LUNAR CARGO LANDER
Carlos A. Hernandez, Sankar Sunder, and Baard Vestgaard 1989 83 p
(Contract NASw-4435)
(NASA-CR-186682; NAS 1.26:186682) Avail: NTIS HC A05/MF A01 CSCL 22B

The first vehicles to land on the lunar surface during the establishment phase of a lunar base will be unmanned lunar cargo landers. These landers will need to be protected against the hostile lunar environment for six to twelve months until the next manned mission arrives. The lunar environment is characterized by large temperature changes and periodic micrometeorite impacts. An automatically deployable and reconfigurable thermal and micrometeorite protection system was designed for an unmanned lunar cargo lander. The protection system is a lightweight multilayered material consisting of alternating layers of thermal and micrometeorite protection material. The protection system is packaged and stored above the lander common module. After landing, the system is deployed to cover the lander using a system of inflatable struts that are inflated using residual fuel (liquid oxygen) from the fuel tanks. Once the lander is unloaded and the protection system is no longer needed, the protection system is reconfigured as a regolith support blanket for the purpose of burying and protecting the common module, or as a lunar surface garage that can be used to sort and store lunar surface vehicles and equipment. A model showing deployment and reconfiguration of the protection system was also constructed. Author

N90-25162*# Michigan Univ., Ann Arbor.
PROJECT EGRESS: EARTHBOUND GUARANTEED REENTRY FROM SPACE STATION. THE DESIGN OF AN ASSURED CREW RECOVERY VEHICLE FOR THE SPACE STATION
Apr. 1990 195 p
(Contract NASw-4435)
(NASA-CR-186657; NAS 1.26:186657) Avail: NTIS HC A09/MF A02 CSCL 22B

Unlike previously designed space-based working environments, the shuttle orbiter servicing the space station will not remain docked the entire time the station is occupied. While an Apollo capsule was permanently available on Skylab, plans for Space Station Freedom call for a shuttle orbiter to be docked at the space station for no more than two weeks four times each year. Consideration of crew safety inspired the design of an Assured Crew Recovery Vehicle (ACRV). A conceptual design of an ACRV was developed. The system allows the escape of one or more crew members from Space Station Freedom in case of emergency. The design of the vehicle addresses propulsion, orbital operations, reentry, landing and recovery, power and communication, and life support. In light of recent modifications in space station design, Project EGRESS (Earthbound Guaranteed ReEntry from Space Station) pays particular attention to its impact on space station operations, interfaces and docking facilities, and maintenance needs. A water-landing medium-lift vehicle was found to best satisfy

project goals of simplicity and cost efficiency without sacrificing safety and reliability requirements. One or more seriously injured crew members could be returned to an earth-based health facility with minimal pilot involvement. Since the craft is capable of returning up to five crew members, two such permanently docked vehicles would allow a full evacuation of the space station. The craft could be constructed entirely with available 1990 technology, and launched aboard a shuttle orbiter. Author

N90-25163# General Electric Co., Philadelphia, PA. Astro-Space Div.
GPHS-RTG RESPONSE TO CHALLENGER TYPE ACCIDENT
Aug. 1989 26 p
(Contract DE-AC01-79ET-32043)
Avail: NTIS HC A03/MF A01

The question: What would have been the response of the General Purpose Heat Source Radioisotope Thermoelectric Generators (GPHS-RTH) on the Galileo spacecraft if they had been on board the Space Shuttle Challenger at the time of its accident, is addressed. Based on the evidence available and the evaluations made from this evidence, the environments resulting from the Challenger accident were not sufficiently severe to threaten the integrity of the RTGs. The conclusion from this evaluation is that had the GPHS-RTGs been aboard the Challenger during its accident, they would have been released intact from the Orbiter and would have separated from the spacecraft. The RTGs would then have fallen and impacted in the ocean with no failure of the fueled clads nor release of any of the radioactive fuel. Thus, if the RTGs had been on board the Challenger, there would not have been any damage to the RTGs of any significance as a result of the accident. The evidence and evaluations that led to this conclusion are discussed. Author

N90-25094# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.
OVERVIEW ON THE HERMES IN-ORBIT CONTROL SYSTEM
Eveline Gottzein, Klaus Janschek, and Wielfried Oesterlin *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 223-234 Presented at the 2nd European Aerospace Conference on Progress in Space Transportation, Bonn-Bad Godesberg, Fed. Republic of Germany, 22-24 May 1989 (For primary document see N90-25075 19-01)
(MBB-UK-0056/89-PUB) Avail: NTIS HC A15/MF A02

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N90-25164*# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
ADVANCED SOLAR-PROPELLED CARGO SPACECRAFT FOR MARS MISSIONS Final Report
Jacqueline AuziasdeTurenne, Mark Beall, Joseph Burianek, Anna Cinniger, Barbrina Dunmire, Eric Haberman, James Iwamoto, Stephen Johnson, Shawn McCracken, and Melanie Miller et al 9 Jun. 1989 297 p
(Contract NASw-4435)
(NASA-CR-186218; NAS 1.26:186218) Avail: NTIS HC A13/MF A02 CSCL 22B

Three concepts for an unmanned, solar powered, cargo spacecraft for Mars support missions were investigated. These spacecraft are designed to carry a 50,000 kg payload from a low Earth orbit to a low Mars orbit. Each design uses a distinctly different propulsion system: A Solar Radiation Absorption (SRA) system, a Solar-Pumped Laser (SPL) system and a solar powered magnetoplasmadynamic (MPD) arc system. The SRA directly converts solar energy to thermal energy in the propellant through a novel process. In the SPL system, a pair of solar-pumped, multi-megawatt, CO2 lasers in sunsynchronous Earth orbit converts solar energy to laser energy. The MPD system used indium phosphide solar cells to convert sunlight to electricity, which powers the propulsion system. Various orbital transfer options are examined for these concepts. In the SRA system, the mother ship transfers the payload into a very high Earth orbit and a small auxiliary propulsion system boosts the payload into a Hohmann transfer to Mars. The SPL spacecraft and the SPL powered spacecraft return to Earth for subsequent missions. The MPD propelled spacecraft, however, remains at Mars as an orbiting space station. A patched conic approximation was used to determine a heliocentric interplanetary transfer orbit for the MPD propelled spacecraft. All three solar-powered spacecraft use an aerobrake procedure to place the payload into a low Mars parking orbit. The payload delivery times range from 160 days to 873 days (2.39 years). Author

N90-25165*# Energy Science Labs., Inc., San Diego, CA.
SEDS EXPERIMENT DESIGN DEFINITION Final Report
Joseph A. Carroll, Charles M. Alexander, and John C. Oldson Feb. 1990 97 p
(Contract NAS8-37380)
(NASA-CR-183909; NAS 1.26:183909) Avail: NTIS HC A05/MF A01 CSCL 22B

The Small Expendable-tether Deployment System (SEDS) was developed to design, build, integrate, fly, and safely deploy and release an expendable tether. A suitable concept for an on-orbit test of SEDS was developed. The following tasks were performed: (1) Define experiment objectives and requirements; (2) Define experiment concepts to reach those objectives; (3) Support NASA in experiment concept selection and definition; (4) Perform analyses and tests of SEDS hardware; (5) Refine the selected SEDS experiment concept; and (6) Support interactive SEDS system definition process. Results and conclusions are given. Author

N90-25166*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
AN EARTH ORBITING SATELLITE SERVICE AND REPAIR FACILITY Final Design Report
Andrew Berndt, Mike Cardoza, John Chen, Gunter Daley, Andy Frizzell, Richard Linton, and Wayne Rast 15 Dec. 1989 140 p

(Contract NASw-4435)
(NASA-CR-186669; NAS 1.26:186669) Avail: NTIS HC A07/MF A01 CSCL 22B

A conceptual design was produced for the Geosynchronous Satellite Servicing Platform (GSSP), an orbital facility capable of repairing and servicing satellites in geosynchronous orbit. The GSSP is a man-tended platform, which consists of a habitation module, operations module, service bay and truss assembly. This design review includes an analysis of life support systems, thermal and power requirements, robotic and automated systems, control methods and navigation, and communications systems. The GSSP will utilize existing technology available at the time of construction, focusing mainly on modifying and integrating existing systems. The entire facility, along with two satellite retrieval vehicles (SRV), will be placed in geosynchronous orbit by the Advanced Launch System. The SRV will be used to ferry satellites to and from the GSSP. Technicians will be transferred from Earth to the GSSP and back in an Apollo-derived Crew Transfer Capsule (CTC). These missions will use advanced telerobotic equipment to inspect and service satellites. Four of these missions are tentatively scheduled per year. At this rate, the GSSP will service over 650 satelites during the projected 25 year lifespan. Author

N90-25167*# Texas Univ., Austin. Dept. of Aerospace Engineering.
SPACE STATION BASED MICROACCELERATION EXPERIMENT PLATFORM Final Report
Katy Barber, Tony Economopoulos, Erik Evenson, Raul Gonzalez, Steve Henson, Enrique Parada, Rick Robinson, Mike Scott, and Bill Spotz May 1990 104 p
(Contract NASw-4435)
(NASA-CR-186659; NAS 1.26:186659) Avail: NTIS HC A06/MF A01 CSCL 22B

Normal Space Station Freedom activities, such as docking, astronauts' movement, equipment vibrations, and space station reboosts, exert forces on the structure, resulting in static or transient accelerations greater than many microgravity experiments can tolerate. A solution to this problem is to isolate experiments on a separate platform free from such disturbances. The Space Station Based Microacceleration Experiment Platform, a proposed solution to the Space Station microgravity experiment problem is described. It is modular in design and can be telerobotically assembled and operated. The Microacceleration Experiment Platform (MEP) consists of a minimum configuration platform to which power, propulsion, propellant, and experiment modules are added. The platform's layout is designed to take maximum advantage of the microgravity field structure in orbit. Author

N90-25168*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THERMAL AND ORBITAL ANALYSIS OF EARTH MONITORING SUN-SYNCHRONOUS SPACE EXPERIMENTS
Brian D. Killough May 1990 16 p
(NASA-TM-101630; NAS 1.15:101630) Avail: NTIS HC A03/MF A01 CSCL 22B

The fundamentals of an Earth monitoring Sun-synchronous orbit are presented. A Sun-synchronous Orbit Analysis Program (SOAP) was developed to calculate orbital parameters for an entire year. The output from this program provides the required input data for the TRASYS thermal radiation computer code, which in turn computes the infrared, solar and Earth albedo heat fluxes incident on a space experiment. Direct incident heat fluxes can be used as input to a generalized thermal analyzer program to size radiators and predict instrument operating temperatures. The SOAP computer code and its application to the thermal analysis methodology presented, should prove useful to the thermal engineer during the design phases of Earth monitoring Sun-synchronous space experiments. Author

N90-25169*# Alabama Univ., Huntsville. Center for Space Plasma and Aeronomic Research.
SPACE STATION CONTAMINATION STUDY: ASSESSMENT OF CONTAMINANT SPECTRAL BRIGHTNESS
D. G. Torr 1990 17 p
(Contracts NAS8-37106; NAS9-17133; NAGw-922)
(NASA-CR-186173; NAS 1.26:186173) Avail: NTIS HC A03/MF A01 CSCL 22B

The results presented show that spectral emissions which arise as a result of vehicle-ambient atmospheric interactions are significant and can become competitive with the natural zodiacal background up to altitudes as high as 400 km for the Vacuun Ultraviolet (VUV) and Visible Infrared Spectra (VIS) for the worst case conditions used. The empirical database on the induced environment of space vehicles is very sparse, and these results are based on a number of assumptions and cannot be regarded as definitive at the present time. Since the technique for doing calculations of this kind was developed in its preliminary form for the purpose of this study, a list of greatly improved estimates are provided of the contamination irradiances. Tasks which are considered most important in order to achieve a higher confidence level for the preliminary conclusions drawn are provided. Author

N90-25170*# Cockerham (John M.) and Associates, Inc., Huntsville, AL.
OPTICAL PROPERTIES MONITOR: EXPERIMENT DEFINITION PHASE Final Report, 16 Sep. 1988 - 29 Sep. 1989
Donald R. Wilkes, Jean M. Bennett, Leigh L. Hummer, Russell A. Chipman, James B. Hadaway, and Larry Pezzaniti Washington NASA May 1990 147 p
(Contract NAS8-37755)
(NASA-CR-4293; NAS 1.26:4293) Avail: NTIS HC A07/MF A01 CSCL 22B

The stability of materials used in the space environment will continue to be a limiting technology for space missions. The Optical Properties Monitor (OPM) Experiment provides a comprehensive space research program to study the effects of the space environment (both natural and induced) on optical, thermal and space power materials. The OPM Experiment was selected for definition under the NASA/OAST In-Space Technology Experiment Program. The results of the OPM Definition Phase are presented. The OPM experiment will expose selected materials to the space environment and measure the effects with in-space optical measurements. In-space measurements include total hemispherical reflectance total integrated scatter and VUV reflectance/transmittance. The in-space measurements will be augmented with extensive pre- and post-flight sample measurements to determine other optical, mechanical, electrical, chemical or surface effects of space exposure. Environmental monitors will provide the amount and time history of the sample exposure to solar irradiation, atomic oxygen and molecular contamination. Author

N90-25171* National Aeronautics and Space Administration, Washington, DC.
SPACE STATION SYSTEMS: A BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 10)
Jun. 1990 352 p
(NASA-SP-7056(10); NAS 1.21:7056(10)) Avail: NTIS HC A16 CSCL 22B

This bibliography lists 1,422 reports, articles, and other documents introduced into the NASA scientific and technical information system between July 1, 1989 and December 31, 1989. Its purpose is to provide helpful information to researchers, designers and managers engaged in Space Station technology development and mission design. Coverage includes documents that define major systems and subsystems related to structures and dynamic control, electronics and power supplies, propulsion, and payload integration. In addition, orbital construction methods, servicing and support requirements, procedures and operations, and missions for the current and future Space Station are included. Author

N90-25172*# TRW Space Technology Labs., Redondo Beach, CA.
CONCEPTUAL DEFINITION OF A HIGH VOLTAGE POWER SUPPLY TEST FACILITY Final Technical Report

John J. Biess, Teh-Ming Chu, and N. John Stevens Dec. 1989 83 p
(Contract NAS3-25089)
(NASA-CR-185216; NAS 1.26:185216) Avail: NTIS HC A05/MF A01 CSCL 22B

NASA Lewis Research Center is presently developing a 60 GHz traveling wave tube for satellite cross-link communications. The operating voltage for this new tube is - 20 kV. There is concern about the high voltage insulation system and NASA is planning a space station high voltage experiment that will demonstrate both the 60 GHz communications and high voltage electronics technology. The experiment interfaces, requirements, conceptual design, technology issues and safety issues are determined. A block diagram of the high voltage power supply test facility was generated. It includes the high voltage power supply, the 60 GHz traveling wave tube, the communications package, the antenna package, a high voltage diagnostics package and a command and data processor system. The interfaces with the space station and the attached payload accommodations equipment were determined. A brief description of the different subsystems and a discussion of the technology development needs are presented. Author

N90-25173*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LUNAR ORBITING MICROWAVE BEAM POWER SYSTEM
Edgar H. Fay (Sverdrup Technology, Inc., Brook Park, OH.) and Ronald C. Cull 1990 9 p Presented at the 25th Intersociety Energy Conversion Engineering Conference, Reno, NV, 12-17 Aug. 1990; cosponsored by AIChE, ANS, SAE, ACS, AIAA, ASME, and IEEE
(NASA-TM-103211; E-5620; NAS 1.15:103211) Avail: NTIS HC A02/MF A01 CSCL 22B

A microwave beam power system using lunar orbiting solar powered satellite(s) and surface rectenna(s) was investigated as a possible energy source for the Moon's surface. The concept has the potential of reduced system mass by placing the power source in orbit. This can greatly reduce and/or eliminate the 14 day energy storage requirement of a lunar surface solar system. Also propellants required to de-orbit to the surface are greatly reduced. To determine the practicality of the concept and the most important factors, a zero-th order feasibility analysis was performed. Three different operational scenarios employing state of the art technology and forecasts for two different sets of advanced technologies were investigated. To reduce the complexity of the problem, satellite(s) were assumed in circular equatorial orbits around the Moon, supplying continuous power to a single equatorial base through a fixed horizontal rectenna on the surface. State of the art technology yielded specific masses greater than 2500 kg/kw, well above projections for surface systems. Using advanced technologies the specific masses are on the order of 100 kg/kw which is within the range of projections for surface nuclear (20 kg/kw) and solar systems (500 kg/kw). Further studies examining optimization of the scenarios, other technologies such as lasers transmitters and nuclear sources, and operational issues such as logistics, maintenance and support are being carried out to support the Space Exploration Initiative (SEI) to the Moon and Mars. Author

N90-25174*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH. Dept. of Engineering Technology.
DYNAMIC ANALYSIS OF SPACE-RELATED LINEAR AND NON-LINEAR STRUCTURES
Paul A. Bosela, Francis J. Shaker, and Demeter G. Fertis (Akron Univ., OH.) 1990 9 p Presented at the Southeast Conference of Theoretical and Applied Mechanics, Atlanta, GA, 22 Mar. 1990
(Grant NAG3-1008)
(NASA-TM-103490; NAS 1.15:103490) Avail: NTIS HC A02/MF A01 CSCL 22B

In order to be cost effective, space structures must be extremely light weight, and subsequently, very flexible structures. The power system for Space Station Freedom is such a structure. Each array consists of a deployable truss mast and a split blanket of photovoltaic solar collectors. The solar arrays are deployed in orbit, and the blanket is stretched into position as the mast is extended. Geometric stiffness due to the preload make this an interesting non-linear problem. The space station will be subjected to various dynamic loads, during shuttle docking, solar tracking, attitude adjustment, etc. Accurate prediction of the natural frequencies and mode shapes of the space station components, including the solar arrays, is critical for determining the structural adequacy of the components, and for designing a dynamic controls system. The process used in developing and verifying the finite element dynamic model of the photo-voltaic arrays is documented. Various problems were identified, such as grounding effects due to geometric stiffness, large displacement effects, and pseudo-stiffness (grounding) due to lack of required rigid body modes. Analysis techniques, such as development of rigorous solutions using continuum mechanics, finite element solution sequence altering, equivalent systems using a curvature basis, Craig-Bampton superelement approach, and modal ordering schemes were utilized. The grounding problems associated with the geometric stiffness are emphasized. Author

N90-25175*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A DESIGN OPTIMIZATION PROCESS FOR SPACE STATION FREEDOM
Robert G. Chamberlain, George Fox, and William H. Duquette 15 Jun. 1990 46 p
(Contract NAS7-918)
(NASA-CR-186851; NAS 1.26:186851; JPL-Publ-90-23) Avail: NTIS HC A03/MF A01 CSCL 22B

The Space Station Freedom Program is used to develop and implement a process for design optimization. Because the relative worth of arbitrary design concepts cannot be assessed directly, comparisons must be based on designs that provide the same performance from the point of view of station users; such designs can be compared in terms of life cycle cost. Since the technology required to produce a space station is widely dispersed, a decentralized optimization process is essential. A formulation of the optimization process is provided and the mathematical models designed to facilitate its implementation are described. Author

N90-25176# European Space Agency, Paris (France).
MATERIALS AND PROCESSES FOR SPACECRAFT: THE ESTEC APPROACH
J. Dauphin (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) Feb. 1990 16 p Revised
(ESA-STM-244; ESA-STM-237; ISSN-0379-4075; ETN-90-96983)
Copyright Avail: NTIS HC A03/MF A01; EPD, ESTEC, Noordwijk, Netherlands, HC 20 Dutch guilders

The approach to materials and processes problems used by ESTEC is described. The approach combines pragmatism with standardization. The need to further formalize the work of the division in tackling larger and more complex future projects is discussed. The need to maintain flexibility and the ability to make ad hoc interventions is stressed. The training of new staff, engineers and technicians in the specialized domain of space materials and processes is identified as the biggest challenge facing ESTEC in preparing itself to meet future challenges. ESA

N90-25177# European Space Agency, Paris (France).
THERMAL PROTECTION SYSTEMS FOR REENTRY AND HYPERSONIC FLIGHT
Harald Twardy (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) May 1990 48 p Transl. into ENGLISH from Thermalschutz von Strukturen fuer den Wiedereintritts- und hypersonischen Flug (Brunswick, Fed. Republic of Germany, DLR), Apr. 1989 48 p Original language document was announced as N90-13577
(ESA-TT-1179; DLR-Mitt-89-14; ETN-90-97080) Avail: NTIS HC A03/MF A01

High thermal loadings on the outer covers of a space

transportation system during reentry into the atmosphere or during hypersonic flight can be overcome only with so called hot structures, which are high-temperature resistant primary structures, or by an effective thermal protection system. The latter consists either of insulating materials or of a combination of insulation and heat-radiating surfaces. A description is given of different concepts and of the specific problems of such insulating structures. In hypersonic aeroplanes with liquid hydrogen as fuel on board, the hydrogen stored at cryogenic temperature must be protected against heating by the hot outer skin. Liquid cooling of the outer skin making use of the high cooling capacity of hydrogen is recommended in this connection. ESA

N90-25095# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.
PLATO: A EUROPEAN PLATEFORM ORBITER CONCEPT
Stephen Ransom and Rainer Hoffmann *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 249-260 Presented at AeroTech 89, Birmingham, England, 31 Oct. - 3 Nov. 1989 (For primary document see N90-25075 19-01)
(MBB-UO-0061/89-PUB) Avail: NTIS HC A15/MF A02

N90-25506*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SOAR 89: SPACE STATION. SPACE SUIT TEST PROGRAM
Joseph J. Kosmo, Philip West, and Michael Rouen *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 61-90 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

N90-25507*# Air Force Systems Command, Hanscom AFB, MA.
SPACECRAFT CONTAMINATION PROGRAMS WITHIN THE AIR FORCE SYSTEMS COMMAND LABORATORIES
Edmond Murad *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 97-98 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

N90-25508*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
CONTAMINATION OF SPACECRAFT BY RECONTACT OF DUMPED LIQUIDS
M. E. Fowler, L. J. Leger, M. E. Donahoo, and P. D. Maley (Rockwell Shuttle Operations Co., Houston, TX.) *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 99-104 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

N90-25510*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
NASA SYSTEMS AUTONOMY DEMONSTRATION PROJECT: ADVANCED AUTOMATION DEMONSTRATION OF SPACE STATION FREEDOM THERMAL CONTROL SYSTEM
Jeffrey Dominick, John Bull, and Kathleen J. Healey *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 113-116 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

N90-25520*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACECRAFT EXTERNAL MOLECULAR CONTAMINATION ANALYSIS
H. K. F. Ehlers *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 171-178 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

N90-25543*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SPACE ENVIRONMENTS AND THEIR EFFECTS ON SPACE AUTOMATION AND ROBOTICS
Henry B. Garrett *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 361-380 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

N90-25554*# Sterling Software, Moffett Field, CA.
REMOTE OPERATION OF AN ORBITAL MANEUVERING VEHICLE IN SIMULATED DOCKING MANEUVERS
Adam R. Brody *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 471-475 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

N90-25557*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTERACTIONS BETWEEN THE SPACE STATION AND THE ENVIRONMENT: A PRELIMINARY ASSESSMENT OF EMI
G. B. Murphy and Henry B. Garrett *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 493-507 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

N90-25564*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TECHNOLOGY FOR AN INTELLIGENT, FREE-FLYING ROBOT FOR CREW AND EQUIPMENT RETRIEVAL IN SPACE
J. D. Erickson, G. J. Reuter, Kathleen J. Healey, and D. E. Phinney (Lockheed Engineering and Sciences Co., Houston, TX.) *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 559-565 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N90-25178*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTEGRATED CONTROLS AND HEALTH MONITORING FOR CHEMICAL TRANSFER PROPULSION
Marc G. Millis and Michael P. Binder (Sverdrup Technology, Inc., Brook Park, OH.) 1990 12 p Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; cosponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-103185; E-6657; NAS 1.15:103185; AIAA-90-2751)
Avail: NTIS HC A03/MF A01 CSCL 22B

NASA is reviewing various propulsion technologies for exploring space. The requirements are examined for one enabling propulsion technology: Integrated Controls and Health Monitoring (ICHM) for Chemical Transfer Propulsion (CTP). Functional requirements for a CTP-ICHM system are proposed from tentative mission scenarios, vehicle configurations, CTP specifications, and technical feasibility. These CTP-ICHM requirements go beyond traditional reliable operation and emergency shutoff control to include: (1) enhanced mission flexibility; (2) continuously variable throttling; (3) tank-head start control; (4) automated prestart and post-shutoff engine check; (5) monitoring of space exposure degradation; and (6) product evolution flexibility. Technology development plans are also discussed. Author

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N90-25179# Royal Aircraft Establishment, Farnborough (England).

T4A THRUSTER STARTING SEQUENCES AND THE DESIGN OF AN ELECTROMAGNETIC SEQUENCER FOR CYCLIC LIFE TESTS

R. C. Hughes and R. Hastings Mar. 1977 26 p Presented at the AIAA International Electric Propulsion Conference, Key Biscayne, FL, 15-17 Nov. 1976 Previously announced in IAA as A77-12991

(RAE-TR-77042; RAE-Space-520; Paper-76-996; BR58353; ETN-90-90946) Copyright Avail: NTIS HC A03/MF A01

Physical parameters of a mercury ion thruster were considered to minimize the consumption of electrical energy and propellant during a flight starting sequence typical of stationkeeping. An optimized sequence which considered operational constraints and component lifetimes was evolved and practiced. The flight sequence was modified for laboratory use and for representative thruster cyclic life tests. An electromechanical sequencer was designed to connect the thruster to laboratory type power supplies by switching at the power supply/thruster interface. The sequencer, which is readily reprogrammable, was designed for thruster life testing. ESA

N90-25180# Royal Aircraft Establishment, Farnborough (England).

A GAS-PHASE HIGH VOLTAGE ELECTRICAL ISOLATOR WITH CONTROLLED BREAKDOWN

J. W. Pye Mar. 1978 22 p Previously announced in IAA as A78-51484

(RAE-TR-78030; RAE-Space-546; BR63013; ETN-90-90950) Copyright Avail: NTIS HC A03/MF A01

An electrical isolation device which incorporated an insulating porous core to assist in electron-ion recombination is described. Designed for isolating an ion thruster from its mercury propellant feed system, it results in stand-off voltages greater than 7 kV at normal operating mercury vapor pressures. Breakdown investigations, leading to the final design, show that operation as a controlled high voltage switch is possible. Life-limiting operating factors are identified. ESA

N90-25181*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ARCJET LOAD CHARACTERISTICS

John A. Hamley 1990 18 p Presented at the 21st International Electric Propulsion Conference, Orlando, FL, 18-20 Jul. 1990; cosponsored by AIAA, DGLR, and JSASS

(NASA-TM-103190; E-5578; NAS 1.15:103190; AIAA-90-2579) Avail: NTIS HC A03/MF A01 CSCL 21H

Experiments were conducted to define the interface characteristics and constraints of 1 kW class arcjets run on simulated decomposition products of hydrazine and power processors. The impacts of power supply output current ripple on arcjet performance were assessed by variation of the ripple frequency from 100 Hz to 100 kHz with 10 percent peak-to-peak ripple amplitude at 1.2 kW. Ripple had no significant effects on thrust, specific impulse or efficiency. The impact of output ripple on thruster lifetime was not assessed. The static and dynamic impedances of the arcjet were quantified with two thrusters of nearly identical configuration. Superposition of an AC component on the DC arc current was used to characterize the dynamic impedance as a function of flow rate and DC current level. A mathematical model was formulated from these data. Both the static and dynamic impedance magnitude were found to be dependent on mass flow rate. The amplitude of the AC component was found to have little effect on the dynamic impedance. Reducing the DC level from 10 to 8 amps led to a large change in the magnitude of the dynamic impedance with no observable phase change. The impedance data compared favorably between the two thrusters. Author

N90-25182*# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.

LABORATORY SIMULATION OF THE EFFECT OF ROCKET THRUST ON A PRECESSING SPACE VEHICLE Final Report

Oscar Alvarez, Henry Bausley, Sam Cohen, Miguel Falcon-Martin, Gary Furumoto, ed., Asikin Horio, David Levitt, and Amy Walsh 22 May 1990 118 p

(Contract NASw-4435)

(NASA-CR-186681; NAS 1.26:186681) Avail: NTIS HC A06/MF A01 CSCL 21H

Ground tests of solid propellant rocket motors have shown that metal-containing propellants produce various amounts of slag (primarily aluminum oxide) which is trapped in the motor case, causing a loss of specific impulse. Although not yet definitely established, the presence of a liquid pool of slag also may contribute to nutational instabilities that have been observed with certain spin-stabilized, upper-stage vehicles. Because of the rocket's axial acceleration, absent in the ground tests, estimates of in-flight slag mass have been very uncertain. Yet such estimates are needed to determine the magnitude of the control authority of the systems required for eliminating the instability. A test rig with an eccentrically mounted hemispherical bowl was designed and built which incorporates a follower force that properly aligns the thrust vector along the axis of spin. A program that computes the motion of a point mass in the spinning and precessing bowl was written. Using various RPMs, friction factors, and initial starting conditions, plots were generated showing the trace of the point mass around the inside of the fuel tank. The apparatus will incorporate future design features such as a variable nutation angle and a film height measuring instrument. Data obtained on the nutational instability characteristics will be used to determine order of magnitude estimates of control authority needed to minimize the sloshing effect. Author

N90-25183*# Sverdrup Technology, Inc., Brook Park, OH.

ROCKET COMBUSTION CHAMBER LIFE-ENHANCING DESIGN CONCEPTS Final Report

Richard J. Quentmeyer Jul. 1990 19 p Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; cosponsored by AIAA, SAE, ASME, and ASEE

(Contract NAS3-25266)

(NASA-CR-185257; E-5564; NAS 1.26:185257; AIAA-90-2116) Avail: NTIS HC A03/MF A01 CSCL 21H

NASA continues to pursue technologies which can lead to an increase in life and reduce the costs of fabrication of the Space Shuttle Main Engine. The joint NASA/Air Force Advanced Launch System Program has set its prime objectives to be high reliability and low cost for their new advanced booster engine. In order to meet these objectives, NASA will utilize the results of several ongoing programs to provide the required technologies. An overview is presented of those programs which address life enhancing design concepts for the combustion chamber. Seven different design concepts, which reduce the thermal strain and/or increase the material strength of the combustion chamber liner wall are discussed. Subscale rocket test results are presented, where available, for life enhancing design concepts. Two techniques for reducing chamber fabrication costs are discussed, as well as issues relating to hydrocarbon fuels/combustion chamber liner materials compatibility. Author

N90-25184*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

AN ANALYSIS OF SPACE POWER SYSTEM MASSES

Barbara H. Kenny (Sverdrup Technology, Inc., Brook Park, OH.), Ronald C. Cull, and M. David Kankam 1990 8 p Proposed for presentation at the 25th Intersociety Energy Conversion

Engineering Conference, Reno, NV, 12-17 Aug. 1990; cosponsored by AIChE, ANS, SAE, ACS, AIAA, ASME, and IEEE
(NASA-TM-103199; E-5597; NAS 1.15:103199) Avail: NTIS HC A02/MF A01 CSCL 21H

Various space electrical power system masses are analyzed with particular emphasis on the power management and distribution (PMAD) portion. The electrical power system (EPS) is divided into functional blocks: source, interconnection, storage, transmission, distribution, system control and load. The PMAD subsystem is defined as all the blocks between the source, storage and load, plus the power conditioning equipment required for the source, storage and load. The EPS mass of a wide range of spacecraft is then classified as source, storage or PMAD and tabulated in a database. The intent of the database is to serve as a reference source for PMAD masses of existing and in-design spacecraft. The PMAD masses in the database range from 40 kg/kW to 183 kg/kW across the spacecraft systems studied. Factors influencing the power system mass are identified. These include the total spacecraft power requirements, total amount of load capacity and physical size of the spacecraft. It is found that a new utility class of power systems, represented by Space Station Freedom, is evolving. Author

N90-25185*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ADVANCED TUBE-BUNDLE ROCKET THRUST CHAMBER
John M. Kazaroff and Albert J. Pavli (Sverdrup Technology, Inc., Brook Park, OH.) 1990 14 p Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; cosponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-103139; E-5491; NAS 1.15:103139; AIAA-90-2726) Avail: NTIS HC A03/MF A01 CSCL 21H

An advanced rocket thrust chamber for future space application is described along with an improved method of fabrication. Potential benefits of the concept are improved cyclic life, reusability, and performance. Performance improvements are anticipated because of the enhanced heat transfer into the coolant which will enable higher chamber pressure in expander cycle engines. Cyclic life, reusability and reliability improvements are anticipated because of the enhanced structural compliance inherent in the construction. The method of construction involves the forming of the combustion chamber with a tube-bundle of high conductivity copper or copper alloy tubes, and the bonding of these tubes by an electroforming operation. Further, the method of fabrication reduces chamber complexity by incorporating manifolds, jackets, and structural stiffeners while having the potential for thrust chamber cost and weight reduction. Author

N90-25186*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A COMPARISON OF ANALYTICAL RESULTS FOR 20 K LOX/HYDROGEN INSTABILITIES
Mark D. Klem and Kevin J. Breisacher Jul. 1990 17 p Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; cosponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-103166; E-5538; NAS 1.15:103166; AIAA-90-2241) Avail: NTIS HC A03/MF A01 CSCL 21H

Test data from NASA Lewis' Effect of Thrust Per Element on Combustion Stability Characteristics of Hydrogen-Oxygen Rocket Engines test program are used to validate two recently released stability analysis tools. The first tool is a design methodology called ROCCID (ROCket Combustor Interactive Design). ROCCID is an interactive design and analysis methodology that uses existing performance and combustion stability analysis codes. The second tool is HICCIP (High frequency Injection Coupled Combustion Instability Program). HICCIP is a recently developed combustion stability analysis model. Using a matrix of models, results from analytic comparisons with 20 K LOX/H2 experimental data are presented. Author

N90-25187*# Sverdrup Technology, Inc., Cleveland, OH.
AUTONOMOUS POWER EXPERT SYSTEM Final Report
Mark J. Ringer and Todd M. Quinn Jul. 1990 8 p Presented at the 25th Intersociety Energy Conversion Engineering Conference, Reno, NV, 12-17 Aug. 1990; cosponsored by AIChE, ANS, SAE, ACS, AIAA, ASME, and IEEE
(Contract NAS3-25266)
(NASA-CR-185263; E-5609; NAS 1.26:185263) Avail: NTIS HC A02/MF A01 CSCL 21H

The goal of the Autonomous Power System (APS) program is to develop and apply intelligent problem solving and control technologies to the Space Station Freedom Electrical Power Systems (SSF/EPS). The objectives of the program are to establish artificial intelligence/expert system technology paths, to create knowledge based tools with advanced human-operator interfaces, and to integrate and interface knowledge-based and conventional control schemes. This program is being developed at the NASA-Lewis. The APS Brassboard represents a subset of a 20 KHz Space Station Power Management And Distribution (PMAD) testbed. A distributed control scheme is used to manage multiple levels of computers and switchgear. The brassboard is comprised of a set of intelligent switchgear used to effectively switch power from the sources to the loads. The Autonomous Power Expert System (APEX) portion of the APS program integrates a knowledge based fault diagnostic system, a power resource scheduler, and an interface to the APS Brassboard. The system includes knowledge bases for system diagnostics, fault detection and isolation, and recommended actions. The scheduler autonomously assigns start times to the attached loads based on temporal and power constraints. The scheduler is able to work in a near real time environment for both scheduling and dynamic replanning. Author

N90-25188*# SECA, Inc., Huntsville, AL.
LOX MANIFOLD TEE ANALYSIS Final Report
Yen-Sen Chen and Peter G. Anderson Mar. 1990 117 p
(Contract NAS8-37285)
(NASA-CR-183994; NAS 1.26:183994; SECA-TR-90-02) Avail: NTIS HC A06/MF A01 CSCL 21H

A 4000 Hz vibration phenomena was observed during the test firings of several space shuttle main engines (SSME). Experimental studies of this phenomena suggest that the problem might be associated with vortex shedding from the vanes within the LOX tee manifold. The objective of this study was to determine the unsteady, 3-D flow associated with these vanes by computational methods to identify and better understand the 4000 Hz vibration phenomena. A flow solver, FDNS, for the turbulent conservation equations was validated for predicting high frequency vortex dynamics and used to predict 2-D and 3-D flows within the LOX tee. 4000 Hz excitation oscillations were predicted for some flows and the entire 3-D flow structure was predicted for LOX tee flow. The complexity of the flow was revealed by this analysis, and computational methods for predicting these high frequency oscillations in future engine systems were established. Author

N90-25189# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Bonn (Germany, F.R.).
THE JET ENGINE: 1932 [DER STRAHLMOTOR: 1932]
Johannes Winkler 1989 180 p In GERMAN
(ISBN-3-922010-49-0; ETN-90-96784) Avail: NTIS HC A09/MF A01

A first publication of a 1932 manuscript about motors is presented. Several topics are addressed: thermodynamics of booster motors, Ziolkouski equations, space vehicles, flight stability, aerodynamic braking, space stations and intercontinental rockets. For mean powers, solid fuels were advisable. In the case of liquid fuels, methane and hydrogen are recommended because of their high potential energy. ESA

N90-25190*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE 30-kW AMMONIA ARCJET TECHNOLOGY Final Report, Jul. 1986 - Dec. 1989
W. D. Deininger, A. Chopra, T. J. Pivirotto, K. D. Goodfellow, and J. W. Barnett 15 Feb. 1990 231 p

(Contract NAS7-918)
(NASA-CR-186850; NAS 1.26:186850; JPL-Publ-90-4) Avail: NTIS HC A11/MF A02 CSCL 21H

The technical results are summarized of a 30 kW class ammonia propellant arcjet technology program. Evaluation of previous arcjet thruster performance, including materials analysis of used thruster components, led to the design of an arcjet with improved performance and thermal characteristics. Tests of the new engine demonstrated that engine performance is relatively insensitive to cathode tip geometry. Other data suggested a maximum sustainable arc length for a given thruster configuration, beyond which the arc may reconfigure in a destructive manner. A flow controller calibration error was identified. This error caused previously reported values of specific impulse and thrust efficiency to be 20 percent higher than the real values. Corrected arcjet performance data are given. Duration tests of 413 and 252 hours, and several tests 100 hours in duration, were performed. The cathode tip erosion rate increased with increasing arc current. Elimination of power source ripple did not affect cathode tip whisker growth. Results of arcjet modeling, diagnostic development and mission analyses are also discussed. The 30 kW ammonia arcjet may now be considered ready for development for a flight demonstration, but widespread application of 30 kW class arcjet will require improved efficiency and lifetime. Author

N90-25093# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.
FIRST VULCAIN ENGINE TEST RESULTS
Helmut Dederra, Dominique Thevenot, and Roberto Sciandra (Fiat Aviazione S.p.A., Turin, Italy) *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 211-222 Presented at the 39th International Astronautical Federation Congress, Bangalore, India, 8-15 Oct. 1988 (For primary document see N90-25075 19-01)
(MBB-UK-0054/88-PUB) Avail: NTIS HC A15/MF A02

N90-25509*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTOMATION IN THE SPACE STATION MODULE POWER MANAGEMENT AND DISTRIBUTION BREADBOARD
Bryan Walls and Louis F. Lollar *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 107-111 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10B

N90-25513*# Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH.
SOLAR ARRAY AUTOMATION LIMITATIONS
Terry M. Trumble *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 127-130 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10A

N90-25521*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AUTONOMOUS POWER EXPERT FAULT DIAGNOSTIC SYSTEM FOR SPACE STATION FREEDOM ELECTRICAL POWER SYSTEM TESTBED
Long V. Truong, Jerry L. Walters, Mary Ellen Roth, Todd M. Quinn, and Walter M. Krawczonek (Sverdrup Technology, Inc., Cleveland, OH.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 181-186 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 21H

N90-25544*# TRW Space Technology Labs., Redondo Beach, CA.
DISCHARGE TRANSIENT COUPLING IN LARGE SPACE POWER SYSTEMS
N. John Stevens and R. P. Stillwell *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 383-391 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10B

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N90-25191*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TENSION FATIGUE OF GLASS/EPOXY AND GRAPHITE/EPOXY TAPERED LAMINATES
Gretchen B. Murri, T. Kevin OBrien, and Satish A. Salpekar (Analytical Services and Materials, Inc., Hampton, VA.) Apr. 1990 65 p
(NASA-TM-102628; NAS 1.15:102628; AVSCOM-TM-90-B-005)
Avail: NTIS HC A04/MF A01 CSCL 11D

Symmetric tapered laminates with internally dropped plies were tested with two different layups and two materials, S2/SP250 glass/epoxy and IM6/1827I graphite/epoxy. The specimens were loaded in cyclic tension until they delaminated unstably. Each combination of material and layup had a unique failure mode. Calculated values of strain energy release rate, G, from a finite element analysis model of delamination along the taper, and for delamination from a matrix ply crack, were used with mode I fatigue characterization data from tests of the tested materials to calculate expected delamination onset loads. Calculated values were compared to the experimental results. The comparison showed that when the calculated G was chosen according to the observed delamination failures, the agreement between the calculated and measured delamination onset loads was reasonable for each combination of layup and material. Author

N90-25192# State Univ. of New York, Buffalo. Dept. of Chemistry.
DECAY RATE AND RESONANCE FLUORESCENCE SPECTRUM OF A MOLECULE NEAR A COMPOSITE MATERIAL SURFACE
Xiao-Shen Li, D. L. Lin, Thomas F. George, Yue Liu, and Qing-Quan Gou (Chengdu Univ. of Science and Technology, China) Mar. 1990 20 p Submitted for publication
(Contract N00014-90-J-1193)
(AD-A219692; UBUFFALO/DC/90/TR-7) Avail: NTIS HC A03/MF A01 CSCL 11/4

Optical properties, both linear and nonlinear, of composite materials with small solid particles distributed randomly in an otherwise homogeneous medium have been the subject of extensive research in recent years. How the volume fraction of small particles affect the frequency dependence of optical properties of the adsorbed molecule was studied, in particular, its spontaneous decay rate and light scattering spectrum. The spontaneous decay rate and resonance fluorescence spectrum of a molecule near the surface of composite materials are calculated in the effective medium approximation. Two substrates are considered: One is a semiconductor containing randomly distributed small dielectric particles and the other a dielectric with metallic particles. Results are analyzed in terms of energy transfer from

the molecule to the substrate as functions of the volume fraction of impurity particles. GRA

N90-25193*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A CREEP MODEL FOR METALLIC COMPOSITES BASED ON MATRIX TESTING: APPLICATION TO KANTHAL COMPOSITES
W. K. Binienda, D. N. Robinson (Akron Univ., OH.), S. M. Arnold, and Paul A. Bartolotta Jun. 1990 19 p
(Grant NAG3-379)
(NASA-TM-103172; E-5550; NAS 1.15:103172) Avail: NTIS HC A03/MF A01 CSCL 11D

An anisotropic creep model is formulated for metallic composites with strong fibers and low to moderate fiber volume percent (less than 40 percent). The idealization admits no creep in the local fiber direction and assumes equal creep strength in longitudinal and transverse shear. Identification of the matrix behavior with that of the isotropic limit of the theory permits characterization of the composite through uniaxial creep tests on the matrix material. Constant and step-wise creep tests are required as a data base. The model provides an upper bound on the transverse creep strength of a composite having strong fibers embedded in a particular matrix material. Comparison of the measured transverse strength with the upper bound gives an assessment of the integrity of the composite. Application is made to a Kanthal composite, a model high-temperature composite system. Predictions are made of the creep response of fiber reinforced Kanthal tubes under interior pressure. Author

N90-25194# Utah Univ., Salt Lake City. Dept. of Materials Science and Engineering.
ALUMINA REINFORCED TETRAGONAL ZIRCONIA (TZP) COMPOSITES
Dinesh K. Shetty 1990 17 p
(Contract DE-FG02-87ER-45312)
(DE90-011871; DOE/ER-45312/3) Avail: NTIS HC A03/MF A01

During the past two years, significant progress was made in the three areas. These are: (1) Studies of Interfacial Debonding and Sliding Friction in Ceramic-Matrix Composites, (2) Processing and Characterization of Alumina-Reinforced tetragonal zirconia (TZP) Composites, and (3) Application of Electrical-Mechanical Analog to Composites. Highlights to the research results in the above three areas are described this report. DOE

N90-25195*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPUTED STRUCTURES OF POLYIMIDES MODEL COMPOUNDS
H. Tai and D. H. Phillips Jun. 1990 99 p Presented at the Recent Advances in Polyimides and Other High Performance Polymers, San Diego, CA, 22-25 Jan. 1990
(NASA-TM-101674; NAS 1.15:101674) Avail: NTIS HC A05/MF A01 CSCL 11D

Using a semi-empirical approach, a computer study was made of 8 model compounds of polyimides. The compounds represent subunits from which NASA Langley Research Center has successfully synthesized polymers for aerospace high performance material application, including one of the most promising, LARC-TPI polymer. Three-dimensional graphic display as well as important molecular structure data pertaining to these 8 compounds are obtained. Author

N90-25196* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SEAMLESS METAL-CLAD FIBER-REINFORCED ORGANIC MATRIX COMPOSITE STRUCTURES AND PROCESS FOR THEIR MANUFACTURE Patent
Raymond M. Bluck, inventor (to NASA), Harold G. Bush, inventor (to NASA), and Robert R. Johnson, inventor (to NASA) 8 May 1990 7 p Filed 21 Oct. 1986 Supersedes N87-18613 (25 - 11, p 1449)
(NASA-Case-LAR-13562-1; US-Patent-4,923,751; US-Patent-Appl-SN-921572; US-Patent-Class-428-35.9; US-Patent-Class-138-141; US-Patent-Class-138-149; US-Patent-Class-138-153; US-Patent-Class-428-367; US-Patent-Class-428-376; US-Patent-Class-428-379) Avail: US Patent and Trademark Office CSCL 11D

A metallic outer sleeve is provided which is capable of enveloping a hollow metallic inner member having continuous reinforcing fibers attached to the distal end thereof. The inner member is then introduced into outer sleeve until inner member is completely enveloped by outer sleeve. A liquid matrix member is then injected into space between inner member and outer sleeve. A pressurized heat transfer medium is flowed through the inside of inner member, thereby forming a fiber reinforced matrix composite material. The wall thicknesses of both inner member and outer sleeve are then reduced to the appropriate size by chemical etching, to adjust the thermal expansion coefficient of the metal-clad composite structure to the desired value. thereby forming a fiber reinforced matrix composite material. The wall thicknesses of both inner member and outer sleeve are then reduced to the appropriate size by chemical etching, to adjust the thermal expansion coefficient of the metal-clad composite structure to the desired value. The novelty of this invention resides in the development of a efficient method of producing seamless metal clad fiber reinforced organic matrix composite structures.
Official Gazette of the U.S. Patent and Trademark Office

N90-25197* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
METHOD OF INSETTING PREDESIGNED DISBOND AREAS INTO COMPOSITE LAMINATES Patent
George E. Dickerson, inventor (to NASA) 8 May 1990 3 p Filed 23 Sep. 1988 Supersedes N89-14258 (27 - 6, p 731)
(NASA-Case-LAR-13225-1; US-Patent-4,923,545; US-Patent-Appl-SN-248018; US-Patent-Class-156-153; US-Patent-Class-156-249; US-Patent-Class-156-289; US-Patent-Class-156-344; US-Patent-Class-427-272; US-Patent-Class-427-282; US-Patent-Class-427-290) Avail: US Patent and Trademark Office CSCL 11D

This invention is a process for producing composite laminates containing interlaminar disbonds of controlled sizes, shapes, and positions within a composite structure. A composite layer is provided for later inclusion within a laminate. The surfaces of this composite layer are solvent cleaned and sandblasted, except in desired disbond areas, which are coated with a releasing surface. A template to mask the bond areas is employed to obtain disbond areas of controlled shapes and sizes. The resulting composite layer is then used in the subsequent manufacture of a laminate, whereby faulty adhesion in the laminate can be studied with prior knowledge of the size, shape, and location of the disbond areas.
Official Gazette of the U.S. Patent and Trademark Office

N90-25198*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LOW VELOCITY INSTRUMENTED IMPACT TESTING OF FOUR NEW DAMAGE TOLERANT CARBON/EPOXY COMPOSITE SYSTEMS
D. G. Lance and A. T. Nettles Jul. 1990 39 p
(NASA-TP-3029; NAS 1.60:3029) Avail: NTIS HC A03/MF A01 CSCL 11D

Low velocity drop weight instrumented impact testing was utilized to examine the damage resistance of four recently developed carbon fiber/epoxy resin systems. A fifth material, T300/934, for which a large data base exists, was also tested for comparison purposes. A 16-ply quasi-isotropic lay-up configuration was used for all the specimens. Force/absorbed energy-time plots were generated for each impact test. The specimens were cross-sectionally analyzed to record the damage corresponding to each impact energy level. Maximum force of impact versus impact energy plots were constructed to compare the various systems for impact damage resistance. Results show that the four new damage tolerant fiber/resin systems far outclassed the T300/934 material. The most damage tolerant material tested was the IM7/1962 fiber/resin system. Author

N90-25199 Aalborg Portland (Denmark). Cement and Concrete Lab.
INTRODUCTION TO COMPACT REINFORCED COMPOSITE
Hans Henrik Bache 1987 17 p Repr. from Nordic Concrete Research Publication (Oslo, Norway, Nordic Concrete Federation), no. 6, 1987 p 19-33
(CBL-Reprint-5; ETN-90-96995) Copyright Avail: Aalborg Portland, Roerdalsvej 11, P.O. Box 165, DK-9100 Aalberg, Denmark

Compact Reinforced Composite (CRC), a type of composite structure, is described. In its cement-based version, CRC is built of a strong and brittle cementitious matrix, toughened with a high concentration of fine steel fibers and further reinforced with a high concentration of larger steel bars. CRC is structurally similar to reinforced concrete but it is much more heavily reinforced and displays mechanical behavior more like that of structural steel, having almost the same strength and extremely high ductility. Estimates of the ranges of properties to be expected of CRC are presented. ESA

N90-25200# Societe Bertin et Cie, Plaisir (France).
INTELLIGENT COMPOSITES CONTAINING MEASURING FIBRE OPTIC NETWORKS FOR CONTINUOUS SELF DIAGNOSIS
P. Sansonetti, M. Lequime, D. Engrand, P. Ferdinand, J. Plantey, D. H. Bowen, R. Davidson, S. S. J. Roberts, M. Crowther, and M. Pleydell (GKN Group Technological Centre, Wolverhampton, England) et al 1989 13 p Repr. from Fiber Optic Smart Structures and Skins 2 (SPIE), v. 1170, 1989 p 211-223 Sponsored in part Commission of the European Communities
(ETN-90-97018) Avail: NTIS HC A03/MF A01

A program aiming to explore the use of optical sensing techniques in composites is described. Several sensor methods (microbending, phase, polarimetric, and multiplexing schemes) were considered. The fabrication issue relating to moulding and filament winding of composite samples containing embedded sensors with emergent pigtails were addressed. The effects of embedded fiber optics on the structural integrity of the composites were investigated by both mechanical testing and by the use of two mathematical modeling techniques, a homogenization method based on continuum mechanics and finite element techniques. Through a suitable choice of sensor dimension, jacketing type and thickness the detrimental effects of the embedded inclusions on mechanical properties can be minimized. This was verified by the experimental determination of deformation fields around optical fibers embedded in composite laminates. ESA

N90-25201# Oxford Univ. (England). Dept. of Engineering Science.
A NUMERICAL MICROMECHANICS ANALYSIS OF THE MECHANICAL PROPERTIES OF A PLAIN WEAVE COMPOSITE
Yuan Chong Zhang (Xian Jiaotong Univ., China) and J. Harding May 1990 15 p Sponsored in part by British Council
(Grant AF-AFOSR-0129-88)
(OUEL-1760/89; ETN-90-97048) Avail: NTIS HC A03/MF A01

The problem of the micromechanics analysis of the elastic constants of a 1-ply plain weave composite using the strain energy equivalency principle with the aid of the finite element method is addressed. By assuming undulation in one direction only the plain weave composite is modeled. A systematic treatment of the relationship between the semi-micromechanical aspects of the woven fabric structure and the macromechanical properties of the fabric composite is presented. The numerical estimation of the various elastic constants of a 1-ply plain weave composite is given. A comparison of the resulting numerical prediction with experimental results shows that the method is valid and suggests that it should be extended to the case of a 2-D undulation model. ESA

N90-25082# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Zentralbereich Technik.
CHARACTERIZATION OF THE CREEP COMPLIANCES J22 AND J66 OF ORTHOTROPIC COMPOSITES WITH PEEK AND EPOXY MATRICES USING THE NONLINEAR VISCOELASTIC RESPONSE OF THE NEAT RESINS
Alexander Horoschenkoff *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 47-52 (For primary document see N90-25075 19-01)
(MBB-Z-0258/89-PUB) Avail: NTIS HC A15/MF A02

N90-25091# Messerschmitt-Boelkow-Blohm G.m.b.H., Hamburg (Germany, F.R.). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
DAMAGE TOLERANCE DEMONSTRATION FOR A310-300 CFPR COMPONENTS
Oguz Goekgoel *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 133-140 Presented at ICAF Symposium, Jerusalem, Israel, 1989 (For primary document see N90-25075 19-01)
(MBB-UT-012/89-PUB) Avail: NTIS HC A15/MF A02

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N90-25202# Lockheed Engineering and Sciences Co., Las Vegas, NV.
PRE-CONCENTRATION METHOD FOR INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY Report, 1 Oct. 1988 - 30 Sep. 1989
J. T. Rowan and E. M. Heithmar (Environmental Protection Agency, Las Vegas, NV.) Feb. 1990 53 p
(Contract EPA-68-03-3249)
(PB90-181348; EPA/600/4-89/043) Avail: NTIS HC A04/MF A01 CSCL 07D

A semi-automated system is used to pre-concentrate Ti, V, Mn, Fe, Co, Ni, Cu, Cd, and Pb. The pre-concentration system accepts digests with acid concentrations equivalent to 0.8 to 1.4 percent nitric acid, neutralizes them and loads them onto a macroporous iminodiacetate resin. The alkali and alkaline earth metals, along with deleterious anions such as chloride, are washed off the resin before the concentrated analytes are eluted with nitric acid. A total of 13 isotopes of the analytes are measured. An examination of the apparent concentration efficiencies, as well as the behavior of two internal standard elements added to the eluant stream, indicates that the elution front matrix enhances the ICP-MS response of the analytes. Investigation of the nature of the blank signals suggests that the detection limits of several of the isotopes could benefit by much larger pre-concentration factors, while those of copper, cadmium and lead are currently limited by reagent purity and laboratory contamination. GRA

N90-25203# Syracuse Univ., NY.
ADLAYER PHYSICS Final Technical Report, Jan. - Oct. 1988
Peter A. Dowden Feb. 1990 8 p
(Contract F30602-88-D-0027; AF Proj. 2305)
(AD-A221064; RADC-TR-89-360) Avail: NTIS HC A02/MF A01 CSCL 07/4

This report summarizes research conducted for an improved understanding of the physics of thin metal overlayers. Specific findings include: (1) the work function of adlayers cannot be determined by simply considering the influences of local chemistry and charge transfer due to chemical bonding; (2) long range crystallographic order has been shown to have influence on electronic structure and density of states in thin metal overlayers; and (3) thin metal films can be strained by changing the lattice

constant of a material; the resulting strain is proportional to the change in the valence band electron structure. GRA

N90-25204# Department of the Navy, Washington, DC.
PREPARATION OF ULTRA-PURE METAL HALIDES Patent Application
Paul E. Nordquist, inventor (to Navy) and Arnold H. Singer, inventor (to Navy) 27 Mar. 1990 15 p
(AD-D014529; US-Patent-Appl-SN-499843) Avail: NTIS HC A03/MF A01 CSCL 07/1

Metal halides are ultrapurified by selective complexation with a complexing agent to form a charged first complex. A ligand forms an oppositely charged second complex with metallic impurities in the metal halide to be purified. A solution containing these complexes is then passed through an ion exchange column and the desired purified metal halide collected. The present method is particularly useful in the production of ultrapure metal halides, such as zirconium fluorinate, for metallic glasses. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N90-25205# Oak Ridge National Lab., TN.
DEVELOPMENT OF A DESIGN METHODOLOGY FOR HIGH TEMPERATURE CYCLIC APPLICATIONS OF MATERIALS WHICH EXPERIENCE CYCLIC SOFTENING
Douglas Marriott and James F. Stubbins Dec. 1988 144 p
Prepared in cooperation with Illinois Univ., Urbana-Champaign
(Contract DE-AC05-84OR-21400)
(DE90-006722; ORNL/Sub-85-55904/02; UILU-ENG-88-4020)
Avail: NTIS HC A07/MF A01

The project has as its original focus the high temperature behavior of 2.25 Cr-1 Mo steel, heat treated to produce a predominantly bainitic microstructure and the load carrying response of components made of this material. Experiments were carried out on uniform and notched specimens under both steady and cyclic loading using specially acquired electromechanical test machines. It emerged that a very important feature of mechanical behavior under the conditions of interest was the strong tendency of this material to cyclically soften, particularly at high temperature in the creep range, giving the illusion of a severe creep fatigue interaction under certain conditions. This finding led to a significant component of the project being devoted to investigation of the effects of local, as opposed to generalized, cyclic softening, and the implications this phenomenon might have on the setting of allowable design stress limits. DOE

N90-25206*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
OXIDATION CHARACTERISTICS OF Ti-14Al-21Nb INGOT ALLOY
Sankara N. Sankaran, Ronald K. Clark, Jalaiah Unnam, and Karl E. Wiedemann (Analytical Services and Materials, Inc., Hampton, VA.) Washington Jul. 1990 24 p
(NASA-TP-3012; L-16658; NAS 1.60:3012) Avail: NTIS HC A03/MF A01 CSCL 11F

Static oxidation kinetics of Ti14Al21Nb (wt pct) ingot alloy were studied in air over the temperature interval of 649 to 1093 C in a thermogravimetric apparatus. The oxidation products were characterized by x ray diffraction, electron microprobe analysis, energy dispersive x ray analysis, and Auger electron spectroscopy. Cross-sections of the oxidized samples were also examined using light and scanning electron microscopy. The oxidation rate was substantially lower than the conventional alloys of titanium, but the kinetics displayed a complex behavior involving two or more oxidation rates depending on the temperature and duration of exposure. The primary oxide formed was TiO2, but this oxide was doped with Nb. Small amounts of Al2O3 and TiN were also present in the scale. Diffusion of oxygen into the alloy was observed and the diffusivity seemed to be dependent on the microstructure of the metal. A model was presented to explain the oxidation behavior of the alloy in terms of the reduction in the oxygen diffusivity in the oxide caused by the modification of the defect structure of TiO2 by Nb ions. Author

N90-25207# Argonne National Lab., IL. Energy Systems Div.
THE EFFECT OF TRACE AMOUNTS OF ANTIMONY ON THE STRUCTURE AND PROPERTIES OF ALUMINUM ALLOY A356.2
B. L. Tuttle, A. Keslinke, D. L. Twarog (American Foundreymens' Society.), and E. J. Daniels 1989 37 p Presented at the 93rd Casting Congress of the American Foundryman's Society, San Antonio, TX, 7-11 May 1989
(Contract W-31-109-eng-38)
(DE90-010461; CONF-8905310-1) Avail: NTIS HC A03/MF A01

This investigation was performed to determine the effect of trace amounts of antimony (Sb) on the microstructure, mechanical properties, and casting properties of strontium-modified A356.2 aluminum alloy that was cast in chemically bonded sand molds. The aluminum-silicon alloys were prepared in a high frequency induction furnace from primary A356.2 ingot of commercial purity. Each melt was grain-refined with aluminum-titanium rod, modified with aluminum-strontium-silicon rod, and degassed with dry nitrogen. Five heats were prepared at each target level of Sb: 0.00, 0.05, 0.10, 0.15 and 0.20 wt percent. Significant changes in mechanical and foundry properties resulted from changes in the morphology of the aluminum-silicon eutectic microstructure at the different Sb concentrations. The principle mechanical property affected was elongation (ductility). At an Sb concentration of 0.00 percent, elongation was 5.3 percent. At a concentration of 0.06 percent, elongation decreased to 2.9 percent. The fluidity of the alloy was also affected. At all three temperatures investigated, fluidity declined approx. 17 percent at 0.14 percent Sb relative to alloy containing no Sb. At an Sb content of 0.26 percent, the fluidity increased approx. 22 percent (relative to that at 0.14 percent Sb) to a value slightly higher than that of the Sr-modified alloy containing no Sb. None of the thermal analysis curves for the five levels of Sb addition indicated a cooling curve inflection that could be attributed to the presence of Sb alone. DOE

N90-25208# Wichita State Univ., KS. National Inst. for Aviation Research.
SCRATCHES AND SHOT PEENING EFFECTS ON THE FATIGUE LIFE OF ALUMINUM-LITHIUM ALLOYS M.S. Thesis
Ali Eftekhari and Jorge E. Talia 1990 93 p
(NIAR-90-15) Avail: NTIS HC A05/MF A01

Production of Al-Li (2090-T3) alloy by powder metallurgy results in a material with surfaces that contain micro and macro defects. In addition, other defects like scratches could be introduced onto the surface during processing and/or assembling with a drastic decrease in fatigue strength. In order to recover from these detrimental effects of surface defects, shot peening has been considered. Unscratched specimens were shot peened and fatigue tested. These experiments provided a stress range in which shot peening was beneficial. Fatigue behavior of specimens that were scratched before or after shot peening also were investigated. The fatigue curves were analyzed and a critical scratch depth was identified. Critical depth is the depth beyond which fatigue life is not fully recoverable by shot peening. Using a scanning electron microscope, the scratch surface and fracture morphology were carefully examined. A mechanism to explain the detrimental and the beneficial effects of shot peening is proposed. Author

N90-25209# Wichita State Univ., KS. National Inst. for Aviation Research.
SURFACE CONDITION EFFECT ON THE FATIGUE BEHAVIOR OF ALUMINUM LITHIUM ALLOYS
Ali Eftekhari and Jorge E. Talia 1990 23 p
(NIAR-90-13) Avail: NTIS HC A03/MF A01

Production of Al-Li (2090-T3) alloy by powder metallurgy results in a material with a surface that contains micro and macro defects. In addition, scratches could be introduced to this surface during

assembling and/or processing with a drastic decrease in fatigue strength. The effects of scratching are so severe that a smooth sample with a scratch of 200 microns will have a fatigue life as a notched sample with K(sub t) = 3, a reduction in fatigue life of about three orders of magnitude. In order to recover this loss, shot peening, polishing, anodizing and some of the combined effects of these techniques have been studied. Depending on the applied stress, the fatigue strength of scratched samples, up to a certain depth, can be partially recovered and some of these treatments have accumulative results on improving the fatigue life. The results are discussed in relation to the potential effects of defects on the nucleation of microcracks and their propagation. Author

N90-25210# Wichita State Univ., KS. National Inst. for Aviation Research.

MECHANISMS FOR SOLID PARTICLE EROSION IN DUCTILE AND BRITTLE MATERIALS M.S. Thesis

Ayman T. Ibrahim and Jorge E. Talia 1990 107 p

(NIAR-90-11) Avail: NTIS HC A06/MF A01

The solid particle erosion properties of brittle, ductile, and semi-ductile materials were investigated using an air-blast-type system with Alumina as abrasive particles. The tested materials were S-glass, Aluminum, and Epoxy resin. Two modes of testing were conducted. For the dynamic mode the samples were mounted on a rotating disk to control the relative tangential velocity of the erodent particles with respect to the samples. The use of this technique allowed the observation of the influence of the tangential velocity on the erosion rate values of the tested materials. The second mode was the static testing during which the samples were held stationary. In addition, scanning electron microscopy was used to investigate the surface morphology of the samples. Based on the dependence of the erosion rate on the tangential and normal velocities and the microscopy observations, the basis for a unified model for the ductile and brittle erosion mechanism is proposed. Author

N90-25211*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THE OXIDATION AND CORROSION OF ODS ALLOYS

Carl E. Lowell and Charles A. Barrett Jun. 1990 25 p Submitted for publication

(NASA-TM-102555; E-4030; NAS 1.15:102555) Avail: NTIS HC A03/MF A01 CSCL 11F

The oxidation and hot corrosion of high temperature oxide dispersion strengthened (ODS) alloys are reviewed. The environmental resistance of such alloys are classified by oxide growth rate, oxide volatility, oxide spalling, and hot corrosion limitations. Also discussed are environmentally resistant coatings for ODS materials. It is concluded that ODS NiCrAl and FeCrAl alloys are highly oxidation and corrosion resistant and can probably be used uncoated. Author

N90-25212# Oak Ridge National Lab., TN. Metals and Ceramics Div.

DEFORMATION AND FRACTURE BEHAVIOR OF TiAl

C. L. Fu and M. H. Yoo 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990

(Contract DE-AC05-84OR-21400)

(DE90-012212; CONF-900466-57) Avail: NTIS HC A02/MF A01

First-principles total-energy calculations of the elastic constants, shear fault energies, and cleavage energies of TiAl are presented. A large elastic shear anisotropy was found along the (011) direction, and high APB energies due to the strong cohesion between Ti and Al layers. Shear faults of SISF SESF, and twin boundary are predicted to be prevalent due to their low energies. The anomalous temperature dependence of flow stress is explained by the cross-slip pinning and fault dragging mechanisms. The intrinsic brittleness of TiAl is discussed in terms of the low mobility of 1/2(110) dislocations. DOE

N90-25213*# Northwestern Univ., Evanston, IL. Basic Industry Research Lab.

FRACTURE-TOUGH, CORROSION-RESISTANT BEARING STEELS Semiannual Progress Report No. 1, 1 Feb. - 31 Jul. 1990

Gregory B. Olson 30 Jul. 1990 43 p

(Grant NAG8-144)

(NASA-CR-186796; NAS 1.26:186796) Avail: NTIS HC A03/MF A01 CSCL 11F

The fundamental principles allowing design of stainless bearing steels with enhanced toughness and stress corrosion resistance has involved both investigation of basic phenomena in model alloys and evaluation of a prototype bearing steel based on a conceptual design exercise. Progress in model studies has included a scanning Auger microprobe (SAM) study of the kinetics of interfacial segregation of embrittling impurities which compete with the kinetics of alloy carbide precipitation in secondary hardening steels. These results can define minimum allowable carbide precipitation rates and/or maximum allowable free impurity contents in these ultrahigh strength steels. Characterization of the prototype bearing steel designed to combine precipitated austenite transformation toughening with secondary hardening shows good agreement between predicted and observed solution treatment response including the nature of the high temperature carbides. An approximate equilibrium constraint applied in the preliminary design calculations to maintain a high martensitic temperature proved inadequate, and the solution treated alloy remained fully austenitic down to liquid nitrogen temperature rather than transforming above 200 C. The alloy can be martensitically transformed by cryogenic deformation, and material so processed will be studied further to test predicted carbide and austenite precipitation behavior. A mechanistically-based martensitic kinetic model was developed and parameters are being evaluated from available kinetic data to allow precise control of martensitic temperatures of high alloy steels in future designs. Preliminary calculations incorporating the prototype stability results suggest that the transformation-toughened secondary-hardening martensitic-stainless design concept is still viable, but may require lowering Cr content to 9 wt. pct. and adding 0.5 to 1.0 wt. pct. Al. An alternative design approach based on strain-induced martensitic transformation during cryogenic forming, thus removing the high martensitic constraint, may permit alloy compositions offering higher fracture roughness. Author

N90-25214# Technical Research Centre of Finland, Espoo. Metallurgy Lab.

HIGH-TEMPERATURE MATERIALS. COATING, WELDING, AND SERVICE TESTS

Kai Laitinen and Jouko Ruusila Aug. 1990 50 p In FINNISH; ENGLISH summary

(VTT-RR-645; ISBN-951-38-3527-8; ISSN-0358-5077; ETN-90-96991) Copyright Avail: NTIS HC A03/MF A01

The effect of high temperatures on materials and coatings is investigated. The properties of selected coatings and the durability of these coatings and some materials are examined. Changes in welded joints caused by high temperatures are examined. Pack aluminization is found to increase the oxidation resistance of steels. The protection provided by thermally sprayed coatings is found to depend on the bonding and porosity of the coatings. The need to carefully take the behavior of all alloying elements into consideration when selecting metallic materials for high temperature use is stressed. ESA

N90-25215# Technical Research Centre of Finland, Espoo. Metals Lab.

CYCLIC STRESS STRAIN BEHAVIOR OF AN AUSTENITIC STAINLESS STEEL POLARIT 778 UNDER VARIABLE AMPLITUDE LOADING

Jussi Solin Aug. 1989 46 p Sponsored by Technology Development Center; Nordic Industrial Foundation

(VTT-RR-647; ISBN-951-38-3529-4; ISSN-0358-5077; ETN-90-96992) Copyright Avail: NTIS HC A03/MF A01

The cyclic strain behavior on an austenitic stainless steel, Polarit 778 (X2 CrNiMoN 20 18 6) under constant and variable amplitude

strain is studied. Cyclic softening is observed in all tests. The stress response is found to depend on the strain history, but the cyclic strain curve for the material can be determined by the spectrum straining method. The amount of softening is about fifteen percent during the fatigue life. Initial hardening is seen before the softening starts. This is possibly attributed to nitride or nitride induced clusters. ESA

N90-25216# Technical Research Centre of Finland, Espoo. Metallurgy Lab.
TEM, POSITRON LIFETIME, AND HARDNESS MEASUREMENTS OF IRRADIATED, COLD-WORKED, AND ANNEALED Zr-1 PERCENT Nb
Pertti Nenonen, Petri Nyberg (Helsinki Univ. of Technology, Espoo, Finland), Tapio Planman, and Matti Valo Sep. 1989 29 p Sponsored by Ministry of Trade and Industry, Finland
(VTT-RR-650; ISBN-951-38-3532-4; ISSN-0358-5077; ETN-90-96993) Copyright Avail: NTIS HC A03/MF A01

Tensile specimens of Zr-1 percent Nb plate irradiated in Loviisa 1 NPP for one year are submitted to tensile tests at 24 and 280 C. Results of these tests are presented. Unirradiated Zr-1 percent Nb plate is used as a reference. Defect structures present in the material are examined under Transmission Electron Microscopes (TEM). Hardness and positron lifetime measurements are made. Four different plate treatement types are tested: recrystallized, (unirradiated), irradiated, heavily cold-worked (unirradiated) and both irradiated and cold-worked. The results are compared to those presented in the reference plates. ESA

N90-25217# European Space Agency, Paris (France).
WEAK-BEAM ELECTRON MICROSCOPY OF DISLOCATION SPLITTING IN TiAl: RELATIONSHIP TO PLASTICITY
Gilles Hug (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) May 1990 290 p Transl. into ENGLISH from Etude par microscopie electronique en faisceau faible de la dissociation des dislocations dans TiAl: relation avec le comportement plastique (Paris, France, ONERA), 1988 158 p Original language document was announced as N89-29253
(ESA-TT-1159; ONERA-NT-1988-3; ETN-90-97076; ETN-88-94815) Avail: NTIS HC A13/MF A01

TiAl is an fcc-related metal alloy, ordered in the structure. It shows an anomalous dependence of the flow stress on temperature with a peak at about 600 C which originates from processes intrinsic to dislocations. A weak-beam dark-field transmission electron microscope study was carried out in order to characterize the dislocations and their fine structure as a function of the deformation temperature. The nature of the Burgers vectors encountered in TiAl depends upon the temperature of the deformation test. Four domains, distinguished by the Burgers vectors of the superdislocations present, were found, centered around given temperatures. ESA

N90-25218# European Space Agency, Paris (France).
NUCLEATION KINETICS IN UNDERCOOLED, CLASS-FORMING METALLIC MELTS
Friedhelm Gillessen (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) May 1990 131 p Transl. into ENGLISH from Keimbildungskinetik in unterkuehlten glasbildenden Metallschmelzen (Cologne, Fed. Republic of Germany, DFVLR), 1989 100 p Original language document was announced as N90-13644
(ESA-TT-1186; DFVLR-FB-89-32; ETN-90-97085) Avail: NTIS HC A07/MF A01

The alloys Pd-77.5Cu-6Si-16.5, Pd-40Ni-40P-20, and Cu-xZr-100-x(x=56,62), which readily form glasses, show sluggish transformation kinetics. They are therefore particularly suitable for investigations on nucleation in undercooled melts and its important role in glass formation. The quasi-containerless technique of fluxing the melt in B2O3 and containerless solidification in a drop tube were used to undercool the melts. The results of the experiments indicate a dependence of both the glass-forming ability and the undercooling behavior on the cooling rate and overheating temperature of the melt. Using an isothermal approach, the nucleation kinetics are analyzed within the framework of classical nucleation theory, allowing the quantitative determination of so-called temperature/time nucleation diagrams for various nucleation processes. ESA

N90-25090# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Unternehmensgruppe Transport- und Verkehrsflugzeuge.
INVESTIGATION ON SHEET MATERIAL OF 8090 AND 2091 ALUMINIUM-LITHIUM ALLOY
Walter Zink, Juergen Weilke, Lueder Schwarmann, and Karl Heinz Rendigs *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 123-132 Presented at AGARD Conference, Mierlo, Netherlands, 2-7 Oct. 1988 (For primary document see N90-25075 19-01)
(MBB-UT-122/89-PUB) Avail: NTIS HC A15/MF A02

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N90-25219*# Washington Univ., Seattle. Dept. of Mechanical Engineering.
THE YIELD AND POST-YIELD BEHAVIOR OF HIGH-DENSITY POLYETHYLENE
M. A. Semeliss, R. Wong, and M. E. Tuttle May 1990 142 p (Grant NAG1-974)
(NASA-CR-186574; NAS 1.26:186574) Avail: NTIS HC A07/MF A01 CSCL 11C

An experimental and analytical evaluation was made of the yield and post-yield behavior of high-density polyethylene, a semi-crystalline thermoplastic. Polyethylene was selected for study because it is very inexpensive and readily available in the form of thin-walled tubes. Thin-walled tubular specimens were subjected to axial loads and internal pressures, such that the specimens were subjected to a known biaxial loading. A constant octahederal shear stress rate was imposed during all tests. The measured yield and post-yield behavior was compared with predictions based on both isotropic and anisotropic models. Of particular interest was whether inelastic behavior was sensitive to the hydrostatic stress level. The major achievements and conclusions reached are discussed. Author

N90-25220# North Carolina State Univ., Raleigh. School of Engineering.
FUNDAMENTAL STUDIES AND DEVICE DEVELOPMENT IN BETA SILICON CARBIDE Final Report, 1 Jan. 1988 - 31 Dec. 1989
Robert F. Davis 28 Feb. 1990 77 p
(Contract N00014-82-K-0182)
(AD-A219253; NCS-MAT/D-0014) Avail: NTIS HC A05/MF A01 CSCL 07/2

The dependence of growth rate of alpha-SiC on alpha-Silicon Carbide substrates and surface morphology on temperature, source gas/carrier gas flow rate ratios, and the degree of off-axis tilt have been investigated. Theoretical and experimental studies of Aluminum and Nitrogen incorporation into 6 Hydrogen-Silicon Carbide films during deposition have also been studied. Device research has involved studies of suitable ohmic and rectifying contacts, and the fabrication and characterization of Schottky and p-n junction diodes as well as Metal-Semiconductor field effect transistors, Metal-oxide-semiconductor field effect transistor and Impact Avalanche transit-time diodes. GRA

N90-25221# Department of the Navy, Washington, DC.
PROCESS OF THREE DIMENSIONAL LITHOGRAPHY IN AMORPHOUS POLYMERS Patent Application
Mark F. Sonnenschein, inventor (to Navy) and Charles M. Roland,

inventor (to Navy) 29 Nov. 1989 24 p
(AD-D014500; US-Patent-Appl-SN-442815) Avail: NTIS HC A03/MF A01 CSCL 07/6

This patent application discloses a process of three dimensional lithography in amorphous polymers to form an instantaneous, permanent image in the polymer by the steps of providing an undoped, non-crystalline layer or film of a polymer having a stable amorphous state under human operating conditions. The film is preferably poly(ethylene terephthalate) (PET), poly(aryl-ether-ether-ketone) (PEEK), poly(chlorotrifluoroethylene) (Kel-F), poly(carbonate) (ie LEXAN 9032), poly(sulfone), poly(methylmethacrylate)(PMMA, or LUCITE), a poly(cyanurate) such as bisphenol A dicyanate, or an epoxy (eg. Epon 820). The film can be either self supporting or mounted on a substrate. The film is then covered (and optionally contacted) with a mask which serves to block the radiation from impinging on where no marking is desired. If the mask is in actual contact with the film, it is capable of also acting as a heat sink. Next, the film is exposed through mask to radiation of sufficient intensity to cause ablation of the exposed areas imparting a distinct, three-dimensional impression in the film. The film may then, for example, be processed by metalization and coating with a protective layer to form a finished product of an optical data storage disk. GRA

N90-25222# Federal Aviation Administration, Atlantic City, NJ.
FLAMMABILITY OF FIRE RESISTANT, AIRCRAFT HYDRAULIC FLUID
David Blake Apr. 1990 17 p
(DOT/FAA/CT-TN90/19) Avail: NTIS HC A03/MF A01

This study was undertaken following a wheel-well fire in a 737 aircraft. Hydraulic fluid appeared to be the fuel for this fire. Twenty-six tests were conducted with Monsanto Skydrol 500B-4 and Chevron Hy-Jet IV-A fire resistant phosphate ester-based hydraulic fluid. The testing was conducted to determine the conditions necessary for ignition and self-sustained burning of these fluids and to attempt to simulate what probably happened in the wheel-well fire. The testing determined that under certain conditions these fluids will ignite and continue to burn after the ignition source is removed. Author

N90-25223*# Georgia Inst. of Tech., Atlanta.
LUNAR REGOLITH BAGGING SYSTEM
Reuben Cannon, Scott Henninger, Mark Levandoski, Jim Perkins, Jack Pitchon, Robin Swats, and Roger Wessels Mar. 1990 66 p
(Contract NASw-4435)
(NASA-CR-186683; NAS 1.26:186683; TEX-4312/ME-4182)
Avail: NTIS HC A04/MF A01 CSCL 11E

A design of a lunar regolith bag and bagging system is described. The bags of regolith are to be used for construction applications on the lunar surface. The machine is designed to be used in conjunction with the lunar SKITTER currently under development. The bags for this system are 1 cu ft volume and are made from a fiberglass composite weave. The machinery is constructed mostly from a boron/aluminum composite. The machine can fill 120 bags per hour and work for 8 hours a day. The man hours to machine hours ratio to operate the machine is .5/8. Author

N90-25224*# Georgia Inst. of Tech., Atlanta. Dept. of Textile/Mechanical Design.
LUNAR REGOLITH BAGGING SYSTEM
Sebrina Brown, Kimberly Lundberg, Ginger McGarity, and Philip Silverman Mar. 1990 94 p
(Contract NASw-4435)
(NASA-CR-186652; NAS 1.26:186652; TEX-4312/ME-4182)
Avail: NTIS HC A05/MF A01 CSCL 11E

A regolith container to be used as a fundamental building block in radiation protection of a habitable lunar base was designed. Parameters for the container are its: size, shape, material, and structural design. Also, a machine was designed to fill the regolith container which is capable of grasping and opening an empty container, filling it, closing it when full, and depositing it on the surface of the Moon. The simple design will bag lunar soil in a relatively short amount of time, with a low equipment weight, and with moving parts distanced from the dirt. The bags are made out of Kevlar 149 with a fabric weight of 6 oz. per square yard. All machine parts are composed of aluminum 6061-T6. Assuming that the vehicle runs at 7 km/hr for 8 hours a day, the machine will bag the necessary 450 cu m of soil in about 12 days. The total mass of the bags and the machine to be shipped to the Moon will be 687 kg. The cost of shipping this weight will be $6.23 million. Author

N90-25225*# Georgia Inst. of Tech., Atlanta. Dept. of Textile/Mechanical Design
SUNLIGHT DIFFUSING TENT FOR LUNAR WORKSITE
Blair Burleson, Todd Clark, Todd Deese, Ernest Gentry, and Abdul Samad Mar. 1990 46 p
(Contract NASw-4435)
(NASA-CR-186651; NAS 1.26:186651; TEX-4312/ME-4182)
Avail: NTIS HC A03/MF A01 CSCL 11E

The purpose is to provide a solution to problems astronauts encounter with sunlight on the lunar surface. Due to the absence of an atmosphere the Moon is subjected to intense sunlight creating problems with color and contrast. This problem can be overcome by providing a way to reduce intensity and diffuse the light in a working environment. The solution to the problem utilizes an umbrella, tent-like structure covered with a diffusing material. The design takes into account structural materials, stresses, fabrics, and deployment. Author

N90-25226# National Aeronautical Establishment, Ottawa (Ontario). Structures and Materials Lab.
PROCESSING OF ADVANCED CERAMICS WHICH HAVE POTENTIAL FOR USE IN GAS TURBINE AERO ENGINES
T. M. Maccagno Feb. 1989 5 p
(AD-A220988; NAE-AN-58; NRC-30057) Avail: NTIS HC A01/MF A01 CSCL 11/3

Si3N4 and SiC based advanced ceramics that were produced by hot isostatic pressing (HIPing) have a good potential to be used as hot section components in gas turbine aero engines. Background is provided for an NAE-SML investigation of this potential. A general overview of the many fabrication methods that were used to produce both monolithic ceramics and SiC whisker reinforced composite ceramics is presented. This is followed by a comprehensive survey of past efforts to produce Si3N4 and SiC based ceramics by HIPing. It is apparent that many of these efforts have involved HIPing of material that was already densified by sintering, but such an approach does not really allow the full benefits of HIP processing to be realized. On the other hand, HIPing of Si3N4 based composite produced by reaction bonding may result in ceramic material of superior quality. Author

N90-25227# Geo-Centers, Inc., Newton, MA.
PREPARATION AND CHARACTERIZATION OF PROPERTIES OF OXYNITRIDE GLASSES AND FIBERS Final Report, Apr. 1986 - Aug. 1988
Robert P. Gleisner, Thomas G. DiGuiseppe, and Donald R. Messier (Army Materials Technology Lab., Watertown, MA.) Jul. 1989 46 p
(Contract DAAL04-86-C-0032; DA Proj. 1L1-61102-AH-42)
(AD-A221334; GC-TR-89-1658; MTL-TR-89-66) Avail: NTIS HC A03/MF A01 CSCL 11/4

It was shown that the substitution of nitrogen for oxygen in oxide glass structures enhances bond strength, which results in glasses having outstanding properties. These oxynitride glasses have higher elastic moduli, tensile strength, hardness, and better corrosion resistance than oxide glasses. Previous work at MTL demonstrated techniques for making significant quantities of these oxynitride glasses. It was also recognized that these glasses had the potential to be formed into glass fibers. Such glass fibers would have potential applications in high performance composites. GRA

N90-25228# Wright Research Development Center, Wright-Patterson AFB, OH. Fuels Branch.
MICRO SEPAROMETER AND BALL-ON-CYLINDER LUBRICITY EVALUATOR TESTS OR CORROSION INHIBITOR/LUBRICITY IMPROVER ADDITIVES Final Report, 19 Jul. 1988 - 31 May 1989
Patricia D. Liberio Sep. 1989 29 p
(AF Proj. 3048)
(AD-A221339; WRDC-TR-89-2098) Avail: NTIS HC A03/MF A01 CSCL 21/4

Due to the addition of the Ball-On-Cylinder Lubricity Evaluator (BOCLE) and Test for Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer to the Military Specification MIL-I-25017, Revision E, all of the Corrosion Inhibitor/Lubricity Improver additives on the Qualified Products List, QPL-25017-15, had to be tested using these methods. During this program each additive was evaluated and the results are given The BOCLE testing resulted in two inhibitors being disqualified from the QPL. The Minimum Effective Concentration (MEC) of eight inhibitors shall be increased in the next revision of QPL-25017. Due to the Micro Separometer (MSEP) testing, two inhibitors shall have new Maximum Allowable Concentration (MAC) and one inhibitor shall be removed from the new QPL. GRA

N90-25229# Department of the Navy, Washington, DC.
ALIGNED BISMUTH, STRONTIUM, CALCIUM CUPRATE COATINGS ON POLYCRYSTALLINE SUBSTRATES Patent Application
L. Toth, inventor (to Navy) and J. R. Spann, inventor (to Navy) 21 Mar. 1990 25 p
(AD-D014522; US-Patent-Appl-SN-497175) Avail: NTIS HC A03/MF A01 CSCL 09/1

The present invention relates in general to a process for forming thick film superconducting coatings on a polycrystalline substrate and, more particularly, to a process for forming a thick film of BiaSrbCacCudOx(BSCCO) on a polycrystalline substrate. A process is provided for forming an oriented thick film superconducting coating on a polycrystalline substrate, the coating comprising at least two highly oriented components. The process is a powdered mixture prepared from Bi2O3, SrCO3, CaCO3, and CuO onto a polycrystalline substrate; rapidly heating the resultant coated substrate to a temperature of from about 1000 to 1100 C for a period of from about 5 to 30 minutes, thereby melting the powder and forming a thick film coating; rapidly quenching the coated substrate to below 500 C, which is below the temperature at which phase transition occurs. GRA

N90-25230# Department of the Navy, Washington, DC.
SELECTIVE METALLIZATION OF CARBONYL-CONTAINING POLYMER FILMS Patent Application
Charles M. Roland, inventor (to Navy) and Mark F. Sonnenschein, inventor (to Navy) 29 Mar. 1990 14 p
(AD-D014526; US-Patent-Appl-SN-500979) Avail: NTIS HC A03/MF A01 CSCL 11/9

The present invention relates generally to the metallization of polymers and more specifically to the metallization of carbonyl-containing polymers. It is an object of the present invention to obtain high resolution metallized images on a polymer film. These and other objects are accomplished by contacting a metal film with, or forming a thin layer of metal, a carbonyl-containing polymer substrate. The image is then formed by exposing selected sections of the coated or overlaid substrate to infrared radiation. The spatial distribution of the radiation impinging on the film is controlled either by a mask or by translation of a well-defined beam of infrared light. The metal in the exposed area adheres to the film, while the metal in the non-exposed area may be easily removed. Adhesion of aluminum and copper to the Polyethylene terephthalate (PET) have been found to pass a standard cellophane adhesive tape test. The present invention is particularly suited to the production of microcontacts for printed circuit boards. GRA

N90-25231# Oak Ridge National Lab., TN. Metals and Ceramics Div.
CRACK BRIDGING PROCESSES IN TOUGHENED CERAMICS
Paul F. Becher 1990 19 p Presented at the NATO Advanced Research Workshop on Toughening Mechanisms in Quasi-brittle Materials, Evanston, IL, 16-20 Jul. 1990
(Contract DE-AC05-84OR-21400)
(DE90-011650; CONF-9007107-1) Avail: NTIS HC A03/MF A01

The fracture toughness of ceramics can be improved by the incorporation of a variety brittle discontinuous reinforcing phases. Observations of crack paths in these systems indicate that these reinforcing phases bridge the crack in the region behind crack tip. Recent developments in toughening models based on crack bridging processes in such systems are discussed and compared to the experimentally observed toughening responses with second phase whisker and self (matrix grain) reinforcement. The bridging model then can be used to optimize the toughening effects based modification of pertinent material characteristics (e.g., microstructure and physical properties). DOE

N90-25232# Los Alamos National Lab., NM. Chemical and Laser Sciences Div.
OXIDE THERMAL STABILITY ON GAMMA TITANIUM ALUMINIDE
Thomas N. Taylor 1990 9 p Presented at the NASP Review and Workshop on Hydrogen-material Interactions, Scottsdale, AZ, 30 May - 1 Jun. 1990
(Contract W-7405-eng-36)
(DE90-012054; LA-UR-90-1808; CONF-9005209-1) Avail: NTIS HC A02/MF A01

Surface composition plays an important role in hydrogen embrittlement of the TiAl-based structural alloys proposed for NASP. A clear understanding of the thermal stability of the oxide on the various titanium aluminides will give important insight into the way that hydrogen reacts with these materials in the initial step of the hydriding process. These issues are addressed by using surface probes to analyze the thermal stability of an oxide formed under atmospheric conditions on gamma titanium aluminide. X ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES) were employed to characterize the surface composition and bonding when the oxidized material is annealed to approximately 600 C in vacuum. The measurements show that the oxygen is largely preserved at the surface while the aluminum-oxide bond becomes more prominent. DOE

N90-25233# Army Materials Technology Lab., Watertown, MA. Materials Science Branch.
X RAY DIFFRACTION ANALYSIS OF CONTROL AND TEST FIBERS Final Report
C. Richard Desper Jun. 1989 13 p
(DA Proj. 1L1-61102-AH-52)
(MTL-TR-89-58) Avail: NTIS HC A03/MF A01

A series of fabric test panels, test fired with a 17-grain fragment simulating projectile (FSP), of armor materials made from Spectra 1000 (Allied-Signal Corporation) high tenacity polyethylene fibers were examined by wide-angle x ray diffraction. A new procedure was developed for averaging out the orientation of fiber or fabric samples in order to yield data suitable for the determination of crystallinity. Data on the undamaged fabric show an average crystallinity of 0.65, with an orthorhombic fraction of 0.61, and the metastable monoclinic phase fraction at 0.04. Ballistic impact resulted at the damage zone in either an increase in the monoclinic fraction, attributable to recrystallization, or to total eradication of the monoclinic phase, attributable to melting. Thus, the monoclinic content is useful for characterizing the thermomechanical effects which the fibers have undergone; monoclinic melting predominates when ballistic penetration is complete. The predominant orthorhombic phase is generally reduced in mass fraction by the ballistic impact event. Author

N90-25234# Argonne National Lab., IL. Energy Systems Div.
OUTLOOK FOR CERAMICS IN HEAT ENGINES, 1990 - 2010: A TECHNICAL AND ECONOMIC ASSESSMENT BASED ON A WORLDWIDE DELPHI SURVEY
R. P. Larsen, A. D. Vyas, A. P. S. Teotia, and L. R. Johnson Feb. 1990 141 p Revised
(Contract W-31-109-eng-38)
(DE90-011262; ANL/ESD-5) Avail: NTIS HC A07/MF A01

The role of advanced ceramic materials in heat engines used in transportation applications was assessed from technical and economic perspectives. Key results are presented from a 1986 worldwide Delphi survey on the expected timing and rate of market development for ceramic engine components and ceramic-intensive engines. Also presented are the benefits of and barriers to the use of ceramic technology in heat engines and factors influencing its rate of adoption. The survey projects that by the mid-1990s, a substantial number of ceramic engine components will be in production and ceramic-intensive engines will be introduced. From the survey data, a computer model produced market penetration curves for individual ceramic engine components in both light- and heavy-duty applications. The model results were combined with price projections to estimate microeconomic effects by component. When aggregated, these projections of economic activity were used as inputs to a macroeconomic model of the U.S. economy, which projected overall economic effects under different scenarios of ceramic technology development. The level of international competition in developing this technology is presented, with implications for economic and technical leadership in this field. Finally, the conditions required for the rapid development of heat engine markets for ceramic technology are discussed. DOE

N90-25235# Sandia National Labs., Albuquerque, NM.
SOL-GEL COATING ON ACOUSTIC WAVE DEVICES: THIN FILM CHARACTERIZATION AND CHEMICAL SENSOR DEVELOPMENT
Gregory G. Frye, C. Jeffrey Brinker, Antonio J. Ricco, Stephen J. Martin, Janice Hilliard, and Daniel H. Doughty 1990 11 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC04-76DP-00789)
(DE90-012224; SAND-89-2802C; CONF-900466-56) Avail: NTIS HC A03/MF A01

We have investigated the use of porous oxide coatings, formed using sol-gel chemistry routes, as the discriminating elements of acoustic wave (AW) chemical sensors. These coatings provide several unique advantages: durability, high adsorption capacity based on large surface areas, and chemical selectivity based on both molecular size and chemical interactions. The porosity of these coatings is determined by performing nitrogen adsorption isotherms using the AW device response to mass changes to monitor the uptake of nitrogen at 77 K. These studies demonstrate how sol-gel chemistry and film-forming technique can be used to tailor the microstructure of thin coatings. The chemical sensitivity and selectivity obtained with this class of coatings will be demonstrated using several examples: hydrous titanate ion exchange coatings, zeolite/silicate microcomposite coatings, and surface-modified silicate films. DOE

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N90-25236# Allied-Signal Corp., Des Plaines, IL. Engineered Materials Research Center.
ADVANCED FUEL PROPERTIES, PHASE 1 Interim Report, Oct. 1987 - May 1989
K. R. Squire, C. L. Vorres, J. T. Donner, J. W. Souza, and M. G. Koehler Dec. 1989 135 p Prepared in cooperation with UOP Research Center, 50 East Algonquin Road, Des Plaines, IL
(Contract F33615-87-C-2709)
(AD-A219788; WRDC-TR-89-2119) Avail: NTIS HC A07/MF A01 CSCL 21/4

To develop fuels needed for the high performance aircraft of the future, the ability to design fuels based on the satisfaction of a set of properties is needed. A project to develop software to accomplish this goal was developed. The ability to determine numerous physical and thermochemical properties of pure-component organic fuel candidates based solely on molecular structure(s) of the molecules of interest is examined. The result of Phase 1 is the software that obtains various physical and thermochemical properties for liquids, ideal gases, and real gases at various temperatures and pressures. Because of the number of methods that were found for predicting properties of molecules, a priority scheme was developed which utilizes the best method to predict the desired property. Additionally, the system has designed within it the ability to interface with an expert system to allow the system to better decide what method(s) should be used to predict each desired property. GRA

N90-25237# Department of the Navy, Washington, DC.
METHOD AND APPARATUS FOR ASSESSING DISTILLATE FUEL STABILITY BY OXYGEN OVERPRESSURE Patent Application
Dennis R. Hardy, inventor (to Navy), Erna J. Beal, inventor (to Navy, and Jack C. Burnett, inventor (to Navy) 27 Jun. 1989 22 p
(AD-D014499; US-Patent-Appl-SN-371782) Avail: NTIS HC A03/MF A01 CSCL 05/2

Reactions leading to insoluble sediments formation in distillate fuel are accelerated by forcing oxygen into solution in the fuel at pressures of between about 90 and 110 psig and then stressing the fuel under conditions of accelerated storage at temperatures of between about 40 to 100 C. The method then makes use of gravimetric determination of the total insolubles formed. The stability of the fuel over a period of time as well as its comparative stability to other fuels can then be predicted from the amount of insolubles formed. The method can be carried out by using a specialized pressure vessel. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N90-25238*# Arizona Univ., Tucson. Coll. of Engineering and Mines.
THE ROLE OF GRAVITY ON MACROSEGREGATION IN ALLOYS Final Report, 30 Apr. 1986 - 29 Apr. 1989
D. R. Poirier, C. F. Chen, and J. C. Heinrich 10 May 1990 65 p
(Grant NAG3-723)
(NASA-CR-186530; NAS 1.26:186530) Avail: NTIS HC A04/MF A01 CSCL 22A

During dendritic solidification liquid flow is induced both by buoyancy forces and solidification shrinkage. There is strong evidence that the major reason for the liquid flow is the former, i.e., thermosolutal convection. In the microgravity environment, it is thought that the thermosolutal convection will be greatly diminished so that convection will be confined mainly to the flow of interdendritic liquid required to satisfy the solidification shrinkage. An attempt is made to provide improved models of dendritic solidification with emphasis on convection and macrosegregation. Macrosegregation is an extremely important subject to the commercial casting community. The simulation of thermosolutal convection in directionally solidified (DS) alloys is described. A linear stability analysis was used to predict marginal stability curves for a system that comprises a mushy zone underlying an all-liquid zone. The supercritical thermosolutal convection in directionally

solidified dendritic alloys was also modeled. The model assumes a nonconvective initial state with planar and horizontal isotherms and isoconcentration that move upward at a constant solidification velocity. Results are presented for systems involving lead-tin alloys and show significant differences with results of plane-front solidification. Author

N90-25239# European Space Agency, Paris (France).
MICROGRAVITY AS A TOOL IN DEVELOPMENTAL BIOLOGY
T. Duc Guyenne, ed. Jan. 1990 87 p Proceedings of a Joint International Society of Developmental Biologists-ESA Symposium, Utrecht, Netherlands, 25 Aug. 1989 Original contains color illustrations
(ESA-SP-1123; ISBN-92-9092-064-5; ISSN-0379-6566; ETN-90-96981) Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

Biological experiments carried out in reduced gravity or microgravity conditions are described. Special attention is given to the role of gravity in biological development. Its effect on the development of mammalian cells, insect development and aging and the axis of polarity in amphibian embryos is studied. The role of gravity in bird development and the role of clinostat rotation on plant protoplasts are studied. Lens and limb regeneration on a newt after a long duration spaceflight is investigated. For individual titles, see N90-25240 through N90-25252.

N90-25240# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Space Biology Group.
MICROGRAVITY AND MAMMALIAN CELLS
A. Cogoli, M. Cogoli, B. Bechler, G. Lorenzi, and F. Gmuender *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 11-19 Sponsored by Swiss National Research Foundation, Berne, and Swiss Federal Inst. of Tech., Zurich (For primary document see N90-25239 19-29)
(Grant ETH-3-338-0-86)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

The effects of microgravity on the proliferation and biosynthesis of mammalian cells cultured in space are studied. It is found that as the response depends on the properties of the cell line investigated, no general conclusions on the effects of microgravity can be drawn. Experiments using human lymphocytes are described. It is found that activation by mitogen is depressed by 97 percent whereas interferon production is increased by 4 to 8 times. Hypotheses are proposed to account for these results. Experiments to be carried out on the future space missions in order to elucidate some remaining questions are described. ESA

N90-25241# Utrecht State Univ. (Netherlands). Dept. of Molecular and Cell Biology.
EPIDERMAL GROWTH FACTOR (EGF) INDUCED SIGNAL TRANSDUCTION IN A431 CELLS IS SENSITIVE TO GRAVITY
P. J. Rijken, R. P. deGroot, W. Kruijer, J. Boonstra, A. J. Verkleij, and S. W. deLaat (Hubrecht Lab., Utrecht, Netherlands) *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 21-28 Sponsored by Space Research Organization Netherlands (For primary document see N90-25239 19-29)
(Grant NWO-783-380-100)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

The influence of gravity on three different processes occurring as a consequence of EGF-induced signal transduction is described. Cell rounding, EGF-receptor clustering and c-fos proto-oncogene expression are the three processes investigated. Simulated weightlessness conditions are shown to enhance EGF-induced cell rounding whereas the same process is inhibited at higher gravity values. EGF-induced C-fos expression is decreased under simulated weightlessness conditions. Preliminary studies indicate that real microgravity conditions decrease EGF-receptor clustering as well as C-fos expression. ESA

N90-25242# Cologne Univ. (Germany, F.R.). Zoologisches Inst.
EARLY MAMMALIAN DEVELOPMENT AND POSSIBLE INVOLVEMENT OF GRAVITY
B. Albers *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 29-34 (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

Post implantation development stages of mammalian embryos are studied. The effect of gravity on development of the blastocyst cavity until implantation is given particular attention. The first polarity found in early cleavage stages of mammalian cells is a radial inside-outside polarity brought about by cell-cell interaction. It is very unlikely that gravity influences these early stages. Post implantation development is not influenced by gravity either, the position of the embryo in the uterus is concluded to be due to interaction between the two. ESA

N90-25243# Universidad Autonoma de Madrid, Cantoblanco (Spain). Dept. de Bioquimica.
MICROGRAVITY EFFECTS ON INSECT DEVELOPMENT AND AGING
R. Marco, I. Vernos, J. Gonzalez-Jurado, M. Maroto, M. Calleja, and M. Carratala *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 35-42 Sponsored by Plan Nacional del Espacio, Madrid, Spain (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

Microgravity is used as a tool in investigating epigenetic theories concerning development and/or aging. The results of spaceflight experiments on Drosophila melanogaster and Carausius morosus are described. In spite of the different developmental strategies of the two animals, very close agreement between the two systems is seen. The results are reviewed in the light of future experiments to be carried out in order to gain a better understanding of the possible mechanisms of microgravity effects on development. ESA

N90-25244# Reed Coll., Portland, OR. Dept. of Biology.
EXPERIMENTAL CONTROL OF AXIS POLARITY IN AMPHIBIAN EMBRYOS
Steven D. Black *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 43-48 Original contains color illustrations (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

The role of gravity in the formation of embryonic axis is discussed. The embryonic axis is used as a reference line around which embryos differentiate structures in their proper spatial arrangement. In amphibia, gravity and centrifugal force can disrupt the normal process of embryonic axis specification resulting in altered axis polarity or twinning. Experiments carried out on spaceflights to date are described. Experiments planned to further study the effect of gravity on amphibian embryo development are outlined. ESA

N90-25245# Hubrecht Lab., Utrecht (Netherlands).
THE FIRST SEVEN MINUTES OF A ZENOPUS EGG FERTILISED ON A SOUNDING ROCKET IN SPACE
G. A. Ubbels, W. Berendsen (Utrecht State Univ., Netherlands), S. Kerkvliet, and J. Narraway *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 49-58 Sponsored by ESA and Space Research Organization Netherlands Original contains color illustrations (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

The results of fertilization experiments carried out on Zenopus eggs on various space flights are described. In one experiment, eggs are labeled with Hoechst 33258, fertilized in space and fixed in glutaraldehyde. Successful sperm/egg fusion is demonstrated by UV-fluorescence of the fusing sperm on return to Earth. In

another experiment, unfixed fertilized eggs are recovered from space, grown on Earth and fixed at regular intervals. After a seemingly normal gastrulation, the larvae show abnormal development of the posterior region. An experiment on Earth in which launch and reentry perturbations are simulated, shows that it is unlikely that the abnormalities are due to reentry stress.
ESA

N90-25246# University Coll., London (England). Dept. of Anatomy and Developmental Biology.
THE ROLE OF GRAVITY IN BIRD DEVELOPMENT
R. Bellairs *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 59-63 Sponsored by British Heart Foundation (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

The role of gravity in establishing dorso-ventral and cranio-caudal polarity in bird embryos is discussed. Experiments carried out on Earth to better understand the processes involved are described. Spaceborne experiments involving the incubation in space of eggs taken from the genital tract of the hen prior to laying are described. Possible ways of overcoming the problems associated with these early stages in birds are discussed. Aspects of bird embryo morphogenesis, other than the establishment of polarity which might be affected by spaceflight are discussed.
ESA

N90-25247# Trondheim Univ. (Norway). Dept. of Botany.
THE EFFECT OF CLINOSTAT ROTATION ON PLANT PROTOPLASTS
T. H. Iversen, C. Baggerud, and O. Rasmussen (Aarhus Univ., Denmark) *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 65-68 Sponsored by Research Council for Science and Humanities Original contains color illustrations (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

Preparatory experiments using fast and slow rotating clinostats to study the effects of simulated weightlessness on cell wall formation and cell division are described. An experiment to be flown on the Space Shuttle in Dec. 1990 is described. The need to delay cell wall regeneration until the samples are in orbit is discussed. Ways in which to delay this process are described. No significant differences are found in cell division between protoplasts rotated on the slow or fast clinostat. Preliminary observations show that fewer cell aggregates are established in flight samples from Biokosmos 9 than in corresponding ground controls. ESA

N90-25248# Vrije Univ., Amsterdam (Netherlands). Dept. of Oral Cell Biology.
AN IN-VITRO TECHNIQUE TO STUDY BONE METABOLISM IN DEVELOPING MOUSE LONG BONE RUDIMENTS UNDER MICROGRAVITY AND COMPRESSION
J. P. Veldhuijzen, J. J. W. A. vanLoon, and E. H. Burger *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 71-73 (For primary document see N90-25239 19-29) (Grant NWO-MG-004)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

Sixteen and seventeen day old fetal mouse long bone rudiments (metatarsalia) are used in studying mineralization and resorption. The long bones are cultured in gas permeable polyethylene culture bags placed in type 1 containers in the Biorack aboard Spacelab. The containers are flushed every two days with a mixture of 5 percent CO2 in air. Some containers are pressurized to culture under increased hydrostatic compression. No difference in the growth, mineralization and resorption of long bones cultured in the spaceborne culture bags and those cultured in a standard tissue culture placed under Earth based laboratory conditions is found. ESA

N90-25249# Hubrecht Lab., Utrecht (Netherlands).
AUTOMATIC EXPERIMENT CONTAINER FOR FERTILISATION OF FROG EGGS IN SPACE: A MULTI-PURPOSE PIECE OF CLASSIFIED SPACE HARDWARE
G. A. Ubbels and H. P. Willemsen (Centrum voor Constructie en Mechanisatie, Nuenen, Netherlands) *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 75-78 Sponsored by ESA and Space Research Organization Netherlands (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

The Automatic Experiment Container (AEC) designed for fertilization of frog eggs in space is described. Similar modules with minor experiment specific modifications are described. Photographs and diagrams of the container are shown. Factors taken into consideration in the design of the container are described. The choice of biologically compatible materials is given particular attention. The use of the container in carrying out experiments on cancer cells and electrofusion experiments is described. ESA

N90-25250# Amsterdam Univ. (Netherlands). Moleculaire Celbiologie.
THE INFLUENCE OF A SOUNDING ROCKET FLIGHT ON SEXUAL ACTIVATION IN CHLAMYDOMONAS GAMETES
R. Demets, A. Tomson, W. vandenBriel, A. Nederbragt, J. deWit, and H. vandenEnde *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 79-80 Sponsored by Space Research Organization Netherlands (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

The influence of microgravity on the mating process of complementary gametes of the green alga Chlamydomonas is studied. The experiment is flown aboard the MASER-3 sounding rocket. Sexual activation in the flown samples is seen to be less pronounced than in the 1 g control samples on the ground. Additional data indicates that the difference is not caused by microgravity. The difference might be caused by the launch during which the cells are subjected to accelerations up to 15 g, strong vibrations and excessive noise. The cell to cell interaction due to microgravity is masked by unwanted side effects. ESA

N90-25251# Manitoba Univ., Winnipeg. Dept. of Botany and Radiology.
SIMULATION OF THE INVERSION OF AMPHIBIAN EGGS IN A GRAVITATIONAL FIELD USING HOLLOW GLASS SPHERES
R. W. Flint, R. Gordon, C. C. Martin, and G. W. Brodland (Waterloo Univ., Ontario) *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 81-83 Sponsored by Spina Bifida Association of Canada, Spina Bifida Association of Manitoba, and Natural Sciences and Engineering Research Council of Canada (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

Experiments carried out to show that shifts in egg development symmetry in microgravity are due to simple hydrodynamics are described. The experimental methods involving hollow glass spheres are summarized. The spheres are rotated through a chosen angle. The flow patterns inside the sphere are noted as the contents move to new gravitational equilibrium positions. Rotation of a sphere from 175 to 180 degrees causes an entirely different axisymmetric motion of the contents. Circumferential flow produces alignment of mechanochemical fibrils into orientations compatible with global rotation. ESA

N90-25252# Academy of Sciences (USSR), Moscow. Inst. of Developmental Biology.
LENS AND LIMB REGENERATION IN NEWT DURING AND AFTER 13-DAY LONG SPACEFLIGHT
V. I. Mitashov, E. N. Grigoryan, S. Y. Tuchkova, E. A. Oigenblik, and I. E. Malchevskaya *In* ESA, Microgravity as a Tool in Developmental Biology Jan. 1990 p 85-92 Prepared in

cooperation with Ministry of Health of the USSR, Moscow (For primary document see N90-25239 19-29)
Avail: NTIS HC A05/MF A01; also available from EPD, ESTEC, Nordwijk, Netherlands, 45 Dutch guilders

A 13 day experiment carried on Biocosmos 7 to study the influence of limb regeneration on newts is summarized. Abnormalities in limb morphogenesis due to regeneration in microgravity are discussed. Abnormalities are observed in limb regeneration of newts submitted to vibrational simulation of launch and landing. The advantages and disadvantages of using newts for investigating the influence of spaceflight factors on regeneration are discussed. ESA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N90-25253# Royal Aircraft Establishment, Farnborough (England).
ION THRUSTERS AND SPACECRAFT CONFIGURATION
B. P. Day and M. D. Palmer Jan. 1974 15 p Presented at the Conference on Electric Propulsion of Space Vehicles, Culham, England, 10-12 Apr. 1973 Previously announced in IAA as A74-26831
(RAE-TM-Space-206; BR39619; ETN-90-90953) Copyright
Avail: NTIS HC A03/MF A01

An analytical expression for the mass of an ion propulsion system which is dependent only on exhaust velocity, thrust, and total impulse is derived. The results are discussed in relation to their effect on spacecraft configuration. ESA

N90-25254# Wichita State Univ., KS. Dept. of Mechanical Engineering.
MECHANICAL PAINT REMOVAL TECHNIQUES FOR AIRCRAFT STRUCTURES M.S. Thesis
J. P. Amro Dec. 1989 97 p
(IAR-89-23) Avail: NTIS HC A05/MF A01

Paint removal was studied by mechanical means, i.e., blasting, from aluminum structural aeronautical materials (2024-T3) and the changes on the surface morphology introduced by the paint removal process are examined. The principal experimental parameters are particle velocity, and particle angle of incidence. An ideal combination of these parameters could yield a stripped aircraft skin substrate with minimal or no damage. Three types of plastic particles were used are: Polyextra, Polyplus, and Type III. Scanning electron microscopy has shown that a potentially damaging surface morphology is formed on the surface of the structural material. Multiple microcracks or fissures generated by the stripping could reduce the life and/or change the engineering properties of the material. It as also found that aluminum material stripped using plastic media particles has a very rough surface that may affect the aerodynamic flow of an airplane. The number of microcracks and degree of surface roughness vary with the particle impact angle and velocity. To minimize or eliminate the damage done to the surface during the plastic particle stripping, it was necessary to change the blasting media to softer and smaller particles. Commercial wheat flour was selected for this purpose. With the substitution of these natural particles, the scanning electron microscopy observations of the stripped surface revealed no potential damage (microcracks or fissures) on the structural material, and the surface roughness was also reduced. Author

N90-25255*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ROTATING-UNBALANCED-MASS DEVICES FOR SCANNING BALLOON-BORNE EXPERIMENTS, FREE-FLYING SPACECRAFT, AND SPACE SHUTTLE/SPACE STATION EXPERIMENTS
Michael E. Polites Jun. 1990 17 p
(NASA-TP-3030; NAS 1.60:3030) Avail: NTIS HC A03/MF A01 CSCL 14B

A new method is presented for scanning balloon-borne experiments, free-flying spacecraft, and gimballed experiments mounted to the space shuttle or the space station. It uses rotating-unbalanced-mass (RUM) devices for generating circular, line, or raster scan patterns and an auxiliary control system for target acquisition, keeping the scan centered on the target, and producing complementary motion for raster scanning. It is ideal for applications where the only possible way to accomplish the required scan is to physically scan the entire experiment or spacecraft as in x ray and gamma ray experiments. In such cases, this new method should have advantages over prior methods in terms of either power, weight, cost, performance, stability, or a combination of these. Author

N90-25256# Sollac, Dunkerque (France).
THE ACCELERATED COOLING IN GTS PLATE MILL
C. Perdrix, M. Lafrance, R. Lecigne, B. Roth, and S. Viannay (Societe Bertin et Cie, Plaisir, France) 1989 30 p Presented at Journees Siderurgiques ATS, Paris, France, 6-7 Dec. 1989
(ETN-90-97019) Avail: NTIS HC A03/MF A01

Requirements in the production of heavy plates were addressed. The thermal and metallurgical requirements leading to the choice of an accelerated cooling process are presented. The characteristics and performances of this process, and some results depicting the metallurgical benefits are presented. ESA

N90-25257# Rockwell International Corp., Golden, CO.
FABRICATING VANADIUM SHEET TO IMPROVE SYMMETRY OF DRAWN PARTS
C. M. Edstrom 31 Dec. 1989 22 p
(Contract DE-AC34-90DP-6234)
(DE90-011253; RFP-4072) Avail: NTIS HC A03/MF A01

The degree of anisotropy in vanadium sheet determines the amount of earing in formed parts and relates to the roundness of the formed part. Experiments with annealing and rolling practices to produce vanadium sheet were undertaken to reduce the earing tendencies of the metal. Earing in formed vanadium hemishells was reduced by cross rolling; and for unidirectionally rolled sheet, increased reduction per rolling pass and proper selection of intermediate annealing temperature reduced the earing. These modifications in the production steps did not adversely affect the grain size or formability of the vanadium, since these characteristics are mostly influenced by the final anneal. DOE

N90-25258# Technical Research Centre of Finland, Espoo. Metals Lab.
CHARACTERISTICS OF THE IAEA CORRELATION MONITOR MATERIAL FOR SURVEILLANCE PROGRAMMES
Kim Wallin, Matti Valo, Rauno Rintamaa, Kari Toerroenen, and Ralf Ahlstrand Aug. 1989 57 p Sponsored by Ministry of Trade and Industry, Finland
(VTT-RR-639; ISBN-951-38-3522-7; ISSN-0358-5077;
ETN-90-96990) Copyright Avail: NTIS HC A04/MF A01

Correlation monitor material developed to meet the needs of the IAEA (International Atomic Energy Association) coordinated research program for optimizing reactor pressure vessel surveillance programs and their analysis is described. The material is intended to serve as a reference within the IAEA for future vessel surveillance programs throughout the world. The results of an extensive evaluation of the material in the as-received condition are presented. The mechanical properties measured at different temperatures include Charpy V notch and instrumented precracked Charpy data. Elastic-plastic fracture toughness is studied. Specimen size and geometry are varied in the tests. Correlations between different fracture properties are evaluated and discussed. ESA

N90-25081# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Zentralbereich Technik.
ADVANCED METHODS FOR THE MICROMACHINING OF SENSORS
Helmut Seidel and Laszlo Csepregi (Fraunhofer-Inst. fuer Mikrostrukturtechnik, Berlin, Germany, F.R.) *In its* Research and Development: Technical and Scientific Publications 1989

1989 p 41-46 Presented at 7th Sensor Symposium, Tokyo, Japan, 30-31 May 1988 (For primary document see N90-25075 19-01)
(MBB-Z-0281/88-PUB) Avail: NTIS HC A15/MF A02

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N90-25259# Research Inst. of National Defence, Linkoeping (Sweden). Dept. of Information Technology.
DIGITAL RADIO LINK: CONTROLLED SIMULATOR FOR FREQUENCY SELECTIVE FADING
Stefan Mattsson Feb. 1989 43 p In SWEDISH; ENGLISH summary Prepared in cooperation with Telub Technik AB, Linkoeping, Sweden
(FOA-C-30527-3.5; TR/895507; ISSN-0347-3708; ETN-90-96582)
Avail: NTIS HC A03/MF A01

A digitally controlled simulator with the capability of simulating multipath fading on microwave line of sight links is described. The performance of the simulator and its components are presented together with a brief description of the hardware. The stochastic channel model behind the simulator is given with the statistical distributions of the parameters in the model. Some applications such as signature analysis and simulation of frequency selective fading are presented. ESA

N90-25260# JAYCOR, Vicksburg, MS.
DESIGN CONCEPTS FOR HARDENED COMMUNICATIONS STRUCTURES Technical Report, 30 Jan. 1986 - 31 Dec. 1987
William J. Flathau and William G. Smith 1 Mar. 1990 174 p
(Contract DNA001-85-C-0412)
(AD-A221233; JAYCOR-J650-87-002/2461; DNA-TR-89-109)
Avail: NTIS HC A08/MF A01 CSCL 09/1

An important component of any hardened command and control structure is the antenna system that provides communication with the outside world. Two types of antennae were considered; i.e., the whip type and the directional. The whip type is for short range communication and the directional is for use primarily with satellites. In the super high frequency range, the use of directional antennae having parabolic dishes greater than 8 feet in diameter are common. In the very extra high frequency range, dishes that are 2 to 3 feet in diameter are used. The whip type antenna should extend up to, say, 60 feet in the air. Based on this background, a family of structures was designed that can protect whip and directional antennae from the blast and shock effects from a 1-MT device for ground surface overpressure ranging from 15,000 to 500 psi. As the antennae, transmitters, receivers, power supplies, and lifting mechanisms will be located within such structures, appropriate shock spectra plots were developed to determine if the fragility level of pertinent equipment will be exceeded and for use in designing shock isolation systems. Button up periods of 1 and 4 weeks were considered. GRA

N90-25261# Dartmouth Coll., Hanover, NH. Dept. of Mathematics and Computer Science.
PRIVACY-ENHANCED ELECTRONIC MAIL
Matt Bishop Jun. 1990 39 p Revised
(PCS-TR90-150-Rev-1) Avail: NTIS HC A03/MF A01

The security of electronic mail sent through the Internet may be described in exactly three words: there is none. The Privacy and Security Research Group has recommended implementing mechanisms designed to provide security enhancements. The first set of mechanisms provides a protocol to provide privacy, integrity, and authentication for electronic mail; the second provides a certificate-based key management infrastructure to support key distribution throughout the internet, to support the first set of mechanisms. These mechanisms are described, as well as the reasons behind their selection and how these mechanisms can be used to provide some measure of security in the exchange of electronic mail. Author

N90-25262# Ames Lab., IA.
TRANSIENT ELECTROMAGNETIC SCATTERING ON ANISOTROPIC MEDIA Ph.D. Thesis - Iowa State Univ.
Rodney D. Stewart Jan. 1990 98 p
(Contract W-7405-eng-82)
(DE90-011802; IS-T-1426) Avail: NTIS HC A06/MF A01

This dissertation treats the problem of transient scattering of obliquely incident electromagnetic plane waves on a stratified anisotropic dielectric slab. Scattering operators are derived for the reflective response of the medium. The internal fields are calculated. Wave splitting and invariant imbedding techniques are used. These techniques are first presented for fields normally incident on a stratified, isotropic dielectric medium. The techniques of wave splitting and invariant imbedding are applied to normally incident plane waves on an anisotropic medium. An integro-differential equation is derived for the reflective response and the direct and inverse scattering problems are discussed. These techniques are applied to the case of obliquely incident plane waves. The reflective response is derived and the direct and inverse problems discussed and compared to those for the normal incidence case. The internal fields are investigated for the oblique incidence via a Green's function approach. A numerical scheme is presented to calculate the Green's function. Finally, symmetry relations of the reflective response are discussed. DOE

N90-25263# Royal Signals and Radar Establishment, Malvern (England).
BINARY PSEUDO RANDOM PHASE CORRELATION IN RADAR SYSTEMS: A NEW APPROACH
M. Dean and Ian Barrow Jan. 1989 23 p
(RSRE-Memo-4223; BR112456; ETN-90-97050) Copyright
Avail: NTIS HC A03/MF A01

Techniques for achieving the correlation of binary pseudo random phase coded signals in Doppler radar sensors are discussed. A new design based on current technology is developed which potentially offers both a low cost and highly integrable solution. Prototype hardware is constructed and tested and its performance compared with other designs. Excellent performance is achievable without the penalties of size and weight which the other designs carry. ESA

N90-25264# Royal Signals and Radar Establishment, Malvern (England).
EXPERIMENTS IN VARIABLE FRAME RATE ANALYSIS FOR SPEECH RECOGNITION
K. M. Ponting and S. M. Peeling 15 Dec. 1989 20 p
(RSRE-Memo-4330; BR113031; ETN-90-97053) Copyright
Avail: NTIS HC A03/MF A01

The application of a simple variable frame rate analysis to the Royal Signals and Radar Establishment (RSRE) Airborne Reconnaissance Mission system, a continuous speech recognition system based on phone-level hidden Markov models, is described. Results are presented which show that, using standard three state models, the addition of the variable frame rate analysis results in considerably improved performance, which is close to that obtained using simple duration sensitive models. ESA

N90-25265# Royal Signals and Radar Establishment, Malvern (England).
THE OPEN-ENDED COAXIAL LINE: A RIGOROUS VARIATIONAL TREATMENT
T. E. Hodgetts Oct. 1989 30 p
(RSRE-Memo-4331; BR112455; ETN-90-97054) Copyright
Avail: NTIS HC A03/MF A01

The open-ended coaxial line with a ground plane or effectively infinite flange has attracted interest as a device for non-destructive

measurement of complex permittivity, e.g., in bio-medical applications. A rigorous theoretical analysis of the open-ended coaxial line with an infinite ground plane or flange radiating into a semi-infinite lossy medium is presented, together with all the essential computational details required to calculate its equivalent admittance at the plane of the open end. ESA

N90-25266# Royal Signals and Radar Establishment, Malvern (England).
SHORT RANGE, CLOSE TO GROUND, VHF/UHF PROPAGATION: A COMPARISON OF MEASURED RESULTS WITH A SIMPLE RAY-BASED MODEL
P. R. Bellamy Oct. 1989 52 p
(RSRE-Memo-4335; BR112454; ETN-90-97056) Copyright Avail: NTIS HC A04/MF A01

A VHF/UHF propagation prediction model and a series of field measurements aimed at verifying the results of the model are described. Comparisons between the model and the trial results were made at spot frequencies from 100 MHz to 900 MHz for several types of antenna and for various heights (not exceeding 2 m) above ground level. The predicted path losses from the model agree quite well with the results of the field measurements. It should be noted that the prediction model was never intended to be a comprehensive tool, merely a utility package which could be incorporated into other software. ESA

N90-25267# European Space Agency, Paris (France).
A DECISION-MAKING AID FOR MULTI-LAYER RADAR ABSORBENT COVERINGS
Annie Bastiere (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) May 1990 291 p Transl. into ENGLISH from Elaboration d'une methode d'aide a la decision pour la realisation de materiaux absorbants radar (Paris, France, ONERA), 1989 249 p Original language document was announced as N89-28703
(ESA-TT-1173; ONERA-NT-1989-2; ETN-90-97078) Avail: NTIS HC A13/MF A02

A multi-criteria optimization method for manufacture of multi-layer radar-absorbent materials intended for cladding of aircraft is presented. This entails firstly the application of an optimization method by nonlinear constraints, the generalized projected gradient; secondly, theoretical and computer-aided application of a decision-making facility employing several different criteria and fusion laws. These laws are obtained by means of two mathematical methods: the first is based on Dempster and Shafer's evidence theory; the other is derived from fuzzy set theory. Several applications of the proposed method, involving firstly triple-layer materials from the same class and secondly materials from different classes whose quantity of layers varies from 1 to 5, are presented. ESA

N90-25268# European Space Agency, Paris (France).
CONCEPTION AND RESULTS OF THE DLR REALTIME AZIMUTH PROCESSOR FOR THE E-SAR SYSTEM
Alberto Moreira (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) May 1990 87 p Transl. into ENGLISH from Entwurf und Ergebnisse des DLR-Echtzeit-Azimutprozessors fuer das E-SAR System (Oberpfaffenhofen, Fed. Republic of Germany, DLR), Jun. 1989 71 p Original language document was announced as N90-12827
(ESA-TT-1184; DLR-FB-89-30; ETN-90-97083) Avail: NTIS HC A05/MF A01

A realtime azimuth processor was developed for the DLR airborne E-SAR (Experimental Synthetic Aperture Radar) system. The azimuth processor uses an unfocused correlation process. This method greatly simplifies signal processing and is easily performed in realtime without any great hardware expenditure. However, a radar image processed by the traditional unfocused method has lower contrast, higher sidelobe amplitudes and inferior resolution than one processed by the focused method. A new algorithm was developed by means of which weighting can be easily introduced into the unfocused processing method. With the exception of the resolution, the image parameters are considerably enhanced and are comparable to a conventional focused processing method. Various images processed in realtime by means of some post-processing techniques are presented. The results of the image analysis correspond to the expected values and prove the validity of the proposed algorithm. ESA

N90-25269# Research Inst. of National Defence, Stockholm (Sweden).
[ACTIVITIES OF THE DIVISION OF SURVEILLANCE AND SEEKER SYSTEMS] Annual Report, 1988 - 1989
Elisabeth Carlsson, ed. and Eva Peterson, ed. Oct. 1989 24 p
(FOA-C-30594; ISSN-0347-3708; ETN-90-97103) Avail: NTIS HC A03/MF A01; Research Inst. of National Defence, P.O. Box 1165, S-581 11 Linkoeping, Sweden, 50 Swedish crowns

The activities of the Surveillance and Seeker Systems Division from 1 Jul. 1988 to 30 Jun. 1990 are reported. The aim of the division is to generate and test new ideas and principles using microwave, optics, electronics and computer technologies. The dependency between sensor systems, target and environmental factors and signal, image and information processing in surveillance, reconnaissance and seeker applications is investigated. ESA

N90-25085# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.
DEVELOPMENT OF AN OPTIMIZED COMPACT TEST RANGE
Evert Dudok, Dietmar Fasold, and Hans-Juergen Steiner *In its* Research and Development: Technical and Scientific Publication 1989 1989 p 69-76 Presented at the 11th ESTEC Antenna Workshop on Antenna Measurements, Gothenburg, Sweden, 20-22 Jun. 1988 (For primary document see N90-25075 19-01)
(MBB-0053/88-PUB) Avail: NTIS HC A15/MF A02

N90-25088# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
FEASIBILITY OF A SYNTHETIC APERTURE RADAR WITH ROTATIVE ANTENNAS (ROSAR)
Helmut Klausing and Horst Kaltschmidt *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 107-113 Presented at AGARD-Avionics Panel Symposium on High Resolution Air and Spaceborne Radar, The Hague, Netherlands, 8-12 Mar. 1989 Sponsored in cooperation with DLR, Oberpfaffenhofen, Fed. Republic of Germany (For primary document see N90-25075 19-01)
(MBB-S/PUB-0385) Avail: NTIS HC A15/MF A02

N90-25096# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Raumfahrt.
CONCEPTS FOR HIGH RESOLUTION SPACE BASED SAR/ISAR SYSTEMS
Claus Boesswetter, Aribert Paul Wolframm, Timothy Kevin Pike, and Jean Michel Hermer (Thomson-CSF, Montrouge, France) *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 261-270 Presented at AGARD Avionics Panel Symposium on High Resolution Air and Spaceborne Radar, The Hague, Netherlands, 8-12 May 1989 (For primary document see N90-25075 19-01)
(MBB-UK-0057/89-PUB) Avail: NTIS HC A15/MF A02

N90-25097# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensgruppe Wehrtechnik.
SYSTEM FOR SHOOTING OF VIDEO IMAGES IN REALTIME [SYSTEM ZUR DREHUNG VON VIDEOBILDERN IN ECHTZEIT]
Peter Wittfoth *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 285-292 In GERMAN (For primary document see N90-25075 19-01)
(MBB-UM-0009/89-PUB) Avail: NTIS HC A15/MF A02

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N90-25270*# E-Tek Dynamics, Inc., San Jose, CA.
HIGH PERFORMANCE MILLIMETER-WAVE MICROSTRIP CIRCULATORS AND ISOLATORS Final Technical Report, Jun. 1988 - Jan. 1990
Ming Shih and J. J. Pan Feb. 1990 155 p
(Contract NAS7-1035)
(NASA-CR-186276; NAS 1.26:186276; Rept-19-F001) Avail: NTIS HC A08/MF A01 CSCL 09A

Millimeter wave systems, phased array antennas, and high performance components all require wideband circulators (and isolators) to perform diplexing and switching, to improve isolation and Voltage Standing Wave Ratio (VSWR), and to construct IMPATT diode reflection amplifiers. Presently, most of the millimeter-wave circulators and isolators are available in the configurations of waveguide or stripline, both of which suffer from the shortcomings of bulky size/weight, narrow bandwidth, and poor compatibility with monolithic millimeter-wave integrated circuits (MMIC). MMW microstrip circulators/isolators can eliminate or improve these shortcomings. Stub-tuned microstrip circulator configuration were developed utilizing the electromagnetic fields perturbation technique, the adhesion problems of microstrip metallization on new ferrite substrate were overcome, the fabrication, assembly, packaging techniques were improved, and then successfully designed, fabricated a Ka band circulator which has isolation and return loss of greater than 16dB, insertion loss less than 0.7dB. To assess the steady and reliable performance of the circulator, a temperature cycling test was done over the range of -20 to +50 C for 3 continuous cycles and found no significant impact or variation of circulator performance. Author

N90-25271 Department of the Navy, Washington, DC.
CMOS ANALOG FOUR-QUADRANT MULTIPLIER Patent
Patrick A. Shoemaker, inventor (to Navy), Gene L. Haviland, inventor (to Navy), and Isaac Lagnado, inventor (to Navy) 6 Mar. 1990 12 p Filed 12 Jan. 1989
(AD-D014507; US-Patent-4,906,873; US-Patent-Appl-SN-297452; US-Patent-Class-307-498) Avail: US Patent and Trademark Office CSCL 09/1

A four-quadrant analog multiplier circuit provides an output which is proportional to two voltage inputs. The circuit includes a pair of depletion mode transistors having gain constants equal in magnitude and threshold voltages equal in magnitude. The gates of the transistors are coupled in common. One input is applied to the common gates. The other input and its inverse are separately applied to source/drain terminals of the two transistors. GRA

N90-25272 Department of the Navy, Washington, DC.
ANALOG ELECTRONIC CONTROL DIFFERENTIAL TRANSMITTER Patent
Jeffrey C. Gremillion, inventor (to Navy) and William P. Huntley, inventor (to Navy) 6 Mar. 1990 12 p Filed 28 Apr. 1989
(AD-D014508; US-Patent-4,906,909; US-Patent-Appl-SN-345817) Avail: US Patent and Trademark Office CSCL 09/1

A linear, analog, synchro control differential transmitter for implementing the common synchro CDX function whereby a scaled linear analog voltage is used as input instead of a mechanical shaft angular displacement. Alternate synchro functions of CT and CX that the invention implements are also disclosed. GRA

N90-25273*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SEQUENTIALLY EVAPORATED THIN FILM YBa2Cu3O(7-x) SUPERCONDUCTING MICROWAVE RING RESONATOR
Norman J. Rohrer, Hing Y. To, George J. Valco, Kul B. Bhasin, Chris Chorey (Sverdrup Technology, Inc., Brook Park, OH.), and Joseph D. Warner 1990 12 p Presented at the Conference on the Science and Technology of Thin Film Superconductors, Denver, CO, 30 Apr. - 4 May 1990; sponsored by DOE
(Contract NCC3-105)
(NASA-TM-103180; E-5557; NAS 1.15:103180; UPI307-51-00)
Avail: NTIS HC A03/MF A01 CSCL 09A

There is great interest in the application of thin film high temperature superconductors in high frequency electronic circuits. A ring resonator provides a good test vehicle for assessing the microwave losses in the superconductor and for comparing films made by different techniques. Ring resonators made of YBa2Cu3O(7-x) have been investigated on LaAlO3 substrates. The superconducting thin films were deposited by sequential electron beam evaporation of Cu, Y, and BaF2 with a post anneal. Patterning of the superconducting film was done using negative photolithography. A ring resonator was also fabricated from a thin gold film as a control. Both resonators had a gold ground plane on the backside of the substrate. The ring resonators' reflection coefficients were measured as a function of frequency from 33 to 37 GHz at temperatures ranging from 20 K to 68 K. The resonator exhibited two resonances which were at 34.5 and 35.7 GHz at 68 K. The resonant frequencies increased with decreasing temperature. The magnitude of the reflection coefficients was in the calculation of the unloaded Q-values. The performance of the evaporated and gold resonator are compared with the performance of a laser ablated YBa2Cu3O(7-x) resonator. The causes of the double resonance are discussed. Author

N90-25274 Department of the Navy, Washington, DC.
MILLIMETER-WAVE MULTIPLEXERS Patent
David Rubin, inventor (to Navy) and Kurt Reinke, inventor (to Navy) 20 Feb. 1990 6 p Filed 29 Mar. 1988
(AD-D014518; US-Patent-4,902,992; US-Patent-Appl-SN-182290)
Avail: US Patent and Trademark Office CSCL 09/1

A planar millimeter wave circuit for splitting a very wide input frequency band into three or more lesser bands utilizes bandpass filters exclusively. A triplexer is made by connecting the bandpass filters with coupled line equivalents fed by a conductor with a characteristic impedance the same as the input conductor to the filters and of an appropriate length so as to make the diplexer appear open or nearly open circuited over the adjacent frequency range of a third bandpass filter used in the triplexer or, alternatively, over the adjacent frequency range of a second diplexer connected so as to form a quadruplexer. GRA

N90-25275# Department of the Navy, Washington, DC.
HIGH FREQUENCY, FREQUENCY MULTIPLIER USING PARALLEL GUNN DIODES Patent Application
Mario Ancona, inventor (to Navy) 30 Mar. 1990 22 p
(AD-D014523; US-Patent-Appl-SN-501571) Avail: NTIS HC A03/MF A01 CSCL 20/3

An object of this invention is to increase the frequency of a Gunn effect oscillator by at least an integer factor. In its broadest form, the invention is a Gunn-effect frequency multiplier having a plurality of semiconducting elements capable of supporting Gunn-effect domains; a cathode and an anode, common to all said semiconducting elements, connecting said elements in parallel; and means for sequentially creating a dipole domain in each of said semiconducting elements during a time substantially less than or equal to the shortest transit time of a dipole domain between said anode for any of said semiconducting elements. GRA

N90-25276# Department of the Army, Washington, DC.
DEVICE AND METHOD FOR DETECTING AND DISPLAYING CROSSOVER PATTERN IN PRECISION WINDING Patent Application
Troy L. Hester, inventor (to Army) 16 Apr. 1990 11 p
(AD-D014539; US-Patent-Appl-SN-509112) Avail: NTIS HC A03/MF A01 CSCL 13/8

In precision winding of fiber, such as optical fiber or natural or synthetic fabric thread, the fiber is wound layer by layer over a tapered cylindrical bobbin. All odd layers are wound in one direction

(example: from left to right) and all even layers are wound in the opposite direction (i.e., from right to left). The device and method for detecting and displaying crossover pattern in precision winding makes it possible to observe crossover patterns without stopping the winding process. A lag angle detector (LAD) is used to detect crossover occurring during a winding process. In conjunction with a suitable circuit built of a differentiator, threshold, angle counter, turn counter, status latch and data latch, the information from LAD can be used to display crossover patterns graphically on a computer monitor and enable observation of the patterns without stopping the winding process. The crossover pattern information can be stored in the computer and retrieved at a later time for underlying layers where visual inspection after completion of winding is impossible. GRA

N90-25277*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
EQUIVALENT CIRCUIT MODELS FOR ac IMPEDANCE DATA ANALYSIS
M. D. Danford Jun. 1990 22 p
(NASA-TM-100402; NAS 1.15:100402) Avail: NTIS HC A03/MF A01 CSCL 09C

A least-squares fitting routine has been developed for the analysis of ac impedance data. It has been determined that the checking of the derived equations for a particular circuit with a commercially available electronics circuit program is essential. As a result of the investigation described, three equivalent circuit models were selected for use in the analysis of ac impedance data. Author

N90-25278*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NEUTRON AND GAMMA IRRADIATION EFFECTS ON POWER SEMICONDUCTOR SWITCHES
G. E. Schwarze and A. J. Frasca (Wittenberg Univ., Springfield, OH.) Aug. 1990 8 p Prepared for presentation at the 25th Intersociety Energy Conversion Engineering Conference, Reno, NV, 12-17 Aug. 1990; cosponsored by AIChE, ANS, SAE, ACS, AIAA, ASME, and IEEE
(NASA-TM-103200; E-5598; NAS 1.15:103200) Avail: NTIS HC A02/MF A01 CSCL 09A

The performance characteristics of high power semiconductor switches subjected to high levels of neutron fluence and gamma dose must be known by the designer of the power conditioning, control and transmission subsystem of space nuclear power systems. Location and the allowable shielding mass budget will determine the level of radiation tolerance required by the switches to meet performance and reliability requirements. Neutron and gamma ray interactions with semiconductor materials and how these interactions affect the electrical and switching characteristics of solid state power switches is discussed. The experimental measurement system and radiation facilities are described. Experimental data showing the effects of neutron and gamma irradiation on the performance characteristics are given for power-type NPN Bipolar Junction Transistors (BJTs), and Metal-Oxide-Semiconductor Field Effect Transistors (MOSFETs). BJTs show a rapid decrease in gain, blocking voltage, and storage time for neutron irradiation, and MOSFETs show a rapid decrease in the gate threshold voltage for gamma irradiation. Author

N90-25279# Sandia National Labs., Albuquerque, NM.
PERFORMANCE OF BATTERY CHARGE CONTROLLERS Interim Report
Ward I. Bower, James P. Dunlop, and Craig W. Maytrott (Florida Solar Energy Center, Cape Canaveral.) 1990 24 p Presented at the 21st IEEE Photovoltaic Specialists Conference, Kissimmee, FL, 21-25 May 1990
(Contract DE-AC04-76DP-00789)
(DE90-011413; SAND-90-1300C; CONF-900542-3) Avail: NTIS HC A03/MF A01

The performance of battery charge controllers and their effects on the system are a critical concern for stand-alone photovoltaic systems with battery storage. Many types of charge controllers are being marketed today, and designers need to understand more about their performance and compatibility with different kinds of batteries and systems. The evaluations and selected interim test results are described from eight different models of small (approximately 10 amps) charge controllers. They are being subjected to a comprehensive test program including thorough electrical characterizations at selected temperatures, photovoltaic inputs and load levels. After electrical characterizations, the charge controllers are divided into concurrent evaluation paths. One path consists of side-by-side operational systems tests in which the charge controllers are installed in identical stand-alone PV systems. The other path consists of continuous environmental and electrical cycling in which the controllers are subjected to programmed electrical inputs, temperatures, and relative humidities. Re-characterizations of all controllers are addition, selected custom tests are performed on identical models to determine response to transients, installation issues and system compatibilities. The data presented here include measured electrical characteristics of the controllers, temperature effects, operational performance, and interface measurements at the array, battery and load. DOE

N90-25280 Technische Univ., Delft (Netherlands). Dept. of Electrical Engineering.
AN APPROACH TO SYSTEMATIC PHASE-LOCK LOOP DESIGN Ph.D. Thesis
Richard Cornelis denDulk 16 Nov. 1989 89 p
(ETN-90-96905) Copyright Avail: Richard C. denDulk, Technische Univ. Delft, Dept. of Electrical Engineering, 2628 BL Delft, Netherlands

The analysis of Phase-Lock Loops (PLL's) is treated from a design point of view i.e., it must contribute to a general procedure for the electronic design of phase-lock (sub)systems. The PLL is studied with an eye to a generalized design method suitable for examining dynamic loop properties. The linear PLL phase model is first analyzed, and properties obtained as a function of the loop filter and input/output topology. The nonlinear PLL phase model is then derived based on the essentially nonlinear operation characteristic of phase detection. The phase-and-frequency detector is investigated and the quadrature loop principle is analyzed. Case studies are given for the operating conditions of a PLL. Circuits and methods for improved PLL performance, based on cycle slip detection are presented. Studies for the digital implementation of a new multiplying phase detection method is proposed. ESA

N90-25099# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Wehrtechnik.
HIGHEST INTEGRATION IN MICROELECTRONICS: DEVELOPMENT OF DIGITAL ASICS FOR PARS3-LR [HOECHSTINTEGRATION IN DER MIKROELEKTRONIK: ENTWICKLUNGEN VON DIGITALEN ASICS FUER PARS3-LR]
Peter Scholler and Rainer vonLutz *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 301-304 In GERMAN Presented at Elektronik-Information, Sep. 1989 (For primary document see N90-25075 19-01)
(MBB-UA-1151/89-PUB) Avail: NTIS HC A15/MF A02

N90-25102# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensbereich Energie- und Industrietechnik.
NEW APPROACH FOR THE THIN LAYER MANUFACTURING: THE WAFER TELEMETRY SYSTEM [NEUE ASPEKTE BEI DER DUENNSCHICHT-HERSTELLUNG: DAS WAFER-TELEMETRIE SYSTEM]
Oswald Stoermer *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 313-318 In GERMAN (For primary document see N90-25075 19-01)
(MBB-UE-0004/89-PUB) Avail: NTIS HC A15/MF A02

N90-25512*# Rome Air Development Center, Griffiss AFB, NY.
SMART BUILT-IN TEST
Dale W. Richards *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and

Robotics (SOAR 1989) Mar. 1990 p 123-126 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N90-25281 Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. de Recherches Hydrauliques.
[ACTIVITIES REPORT OF THE HYDRAULICS RESEARCH LABORATORY] Annual Report, 1988 [RAPPORT ANNUEL 1988 DU LABORATOIRE DE RECHERCHES HYDRAULIQUES]
1988 121 p In ENGLISH and FRENCH Proceedings of the 22th Conference of the IAHR, Lausanne, Switzerland, 31 Aug. - 4 Sep. 1987
(ETN-90-96568) Avail: Ecole Polytechnique Federale, Lab. de Recherches Hydrauliques, CH 1015 Lausanne, Switzerland

Research undertaken during 1988 concerning the fluid dynamics of rivers and hydrodynamics of Lake Geneva, Switzerland, is reported. Flow resistance and velocity distribution in open channel flow and laboratory flumes was studied. Mathematical models for predicting water flow and mixing, related to Lake Geneva, were studied. Seasonal variations of the hypolimnion, metalimnion, and thermoclines were considered. For individual titles, see N90-25282 through N90-25288.

N90-25282 Ecole Polytechnique Federale de Lausanne (Switzerland).
FLOW RESISTANCE AND CRITICAL SHEAR STRESS IN STEEP CHANNELS
B. Kironoto and W. H. Graf *In its* Activities Report of the Hydraulics Research Laboratory 1988 9 p (For primary document see N90-25281 19-34)
Avail: Ecole Polytechnique Federale, Lab. de Recherches Hydrauliques, CH 1015 Lausanne, Switzerland

The flow resistance and the critical shear stress in steep channels are investigated, using a velocity distribution law as elaborated by Tu, Tsujimoto et Graf. The friction factor can be predicted with the flow resistance relations together with numerical constants of integration. Two laboratory data and two field data sets are used to examine the validity. The experimental data from seven different sources were investigated to study the initial (critical) shear stress for steep channels. The Shields diagram is not valid when the relative roughness is important. A useful diagram is proposed to determine the initial sediment movement when the relative roughness is important. A close relationship between velocity distributions and the initial critical shear stress is found.
ESA

N90-25283 Ecole Polytechnique Federale de Lausanne (Switzerland).
VELOCITY DISTRIBUTION IN A GRAVEL-BED FLUME; FOR STEADY AND UNSTEADY FLOW
T. U. Haizhou and W. H. Graf *In its* Activities Report of the Hydraulics Research Laboratory 1988 15 p (For primary document see N90-25281 19-34)
Avail: Ecole Polytechnique Federale, Lab. de Recherches Hydrauliques, CH 1015 Lausanne, Switzerland

The velocity distributions in both steady and unsteady flows in a gravel-bed flume were measured with micropropellers. It is shown that, for steady flows: the additional term Br in the velocity distribution equation is a function of both the relative roughness and the Froude number, and while the velocity fluctuation V value gets its maximum of about 0.1 near the bottom, the maximum velocity fluctuation u value is around 1. For unsteady flows: in simulation of the hydrographs in natural mountain rivers, two hydrographs were created and each one repeated for more than 100 times in the laboratory; for an equal water depth, the velocity in the rising branch is generally larger than that in the falling branch; the velocity profiles are analyzed; the friction velocity, calculated from the St. Venant equation, is also larger in the rising branch and the time lags among the water discharge, the water depth, the vertical mean velocity, and the friction velocity are observed.
ESA

N90-25284 Ecole Polytechnique Federale de Lausanne (Switzerland).
SPATIALLY ACCELERATING FLOW IN SMOOTH OPEN CHANNEL
W. H. Graf, A. Cardoso, and G. Gust (University of South Florida, Saint Petersburg.) *In its* Activities Report of the Hydraulics Research Laboratory 1988 8 p (For primary document see N90-25281 19-34)
Avail: Ecole Polytechnique Federale, Lab. de Recherches Hydrauliques, CH 1015 Lausanne, Switzerland

Laboratory experiments on the structure of fully developed smooth and steady open channel flows gradually subjected to spatial acceleration are reported. Mean velocity and turbulence intensity profiles as well as friction velocity were measured. It was found that: self-similarity is not preserved over the entire depth of the accelerated flow; a very thin universal wall layer is likely to prevail; the turbulence intensity distribution of uniform open channel flows does not hold for the accelerated flow; the Clauser's method for the calculation of the friction velocity leads to erroneous results when applied to the velocity measurements obtained outside of the mentioned thin wall layer.
ESA

N90-25285 Ecole Polytechnique Federale de Lausanne (Switzerland).
GRAIN-SIZE DISTRIBUTION AND ARMORING IN GRAVEL-BED RIVERS: A CASE STUDY
W. H. Graf and L. Correia *In its* Activities Report of the Hydraulics Research Laboratory 1988 11 p (For primary document see N90-25281 19-34)
Avail: Ecole Polytechnique Federale, Lab. de Recherches Hydrauliques, CH 1015 Lausanne, Switzerland

A particular aspect of the armoring phenomenon, namely the relation between the grain sizes of the top layer (armored layer), and the one of the subsurface material (bed layer) in a river bed is studied. An analysis of the existing methods for prediction of the grain size distribution of the armored layer is presented. A new method, based on the adoption of a one parameter exponential distribution for the grain sizes of the armored and the bed layer of a gravel bed river is proposed. Its generalization is examined.
ESA

N90-25286 Ecole Polytechnique Federale de Lausanne (Switzerland).
A TWO LAYER MODEL FOR THE SIMULATION OF INTERNAL LINEAR AND NONLINEAR WAVES IN LAKE GENEVA (SWITZERLAND) [MODELE A DEUX COUCHES POUR LA SIMULATION DES ONDES INTERNES LINEAIRES ET NON-LINEAIRES DANS LE LEMAN]
P. M. Beckers and W. H. Graf *In its* Activities Report of the Hydraulics Research Laboratory 1988 20 p In FRENCH; ENGLISH summary (For primary document see N90-25281 19-34)
Avail: Ecole Polytechnique Federale, Lab. de Recherches Hydrauliques, CH 1015 Lausanne, Switzerland

A nonstationary and fully nonlinear mathematical model to investigate internal waves motions in Lake Geneva, Switzerland is proposed. The model may be regarded as a unified theory of the two layer models commonly used in limnology mainly for the two following reasons: the model includes all the dominant features of baroclinic motions; it takes the real depth distributions and the nonlinear contributions of pressure gradient into account. The shallow water approximation was included and a zero transport over the entire column (the two layers) was assumed. The concept of a generalized equivalent depth, function of the horizontal

coordinates and time, was introduced, generalizing the classical equivalent depth. Another contribution of this model is an improved description of nonlinear interactions between depth and thermocline elevations in the coastal regions. ESA

N90-25287 Ecole Polytechnique Federale de Lausanne (Switzerland).
STUDY OF SEASONAL VARIATION OF MIXING PHENOMENA IN THE HYPOLIMNION OF LAKE GENEVA (SWITZERLAND) [ETUDE DE LA VARIATION SAISONNIERE DES PHENOMENES DE MELANGE DANS L'HYPOLIMNION DU LEMAN]
U. Lemmin, C. Perrinjacquet, and W. H. Graf *In its* Activities Report of the Hydraulics Research Laboratory 1988 26 p In FRENCH; ENGLISH summary (For primary document see N90-25281 19-34)
Avail: Ecole Polytechnique Federale, Lab. de Recherches Hydrauliques, CH 1015 Lausanne, Switzerland

Temperature profiles taken at several stations at intervals of 2 weeks to 1 month indicate that during 1988, due to the clement Winter no change of temperature occurred in the lowest 50 m of the great lake. During the same time the intermediate layers gained in heat content, most evident by the downward propagation of the 5.2 C isotherm by more than 100 m. During Summer stratification the gradient of heat content of the upper 80 m is comparable to the previous year. Over the last three years the great lake shows a trend of heat gain. Currents measured in the passage between the small lake and the great lake during Autumn and Winter near the lake bottom correlate with the prevailing winds. During bise events water from the small lake is pushed into the great lake at speeds at which sediment resuspension can be expected. In the deep hypolimnion of the great lake currents are much smaller and cyclic. The effects of the Coriolis force in deflecting currents to the right is evident in both the currents in the passage between the two lake basins and in the deep hypolimnion. ESA

N90-25288 Ecole Polytechnique Federale de Lausanne (Switzerland).
ON THE FINE-SCALE MIXING IN THE METALIMNION AND THE SEASONAL THERMOCLINE OF THE LEMAN (LAKE GENEVA, SWITZERLAND)
Z. Vecsernyes, U. Lemmin, and W. H. Graf *In its* Activities Report of the Hydraulics Research Laboratory 1988 17 p (For primary document see N90-25281 19-34)
Avail: Ecole Polytechnique Federale, Lab. de Recherches Hydrauliques, CH 1015 Lausanne, Switzerland

A measurement campaign was carried out from 31 Aug. to 30 Sep. 1988 in the northern part of Lake Geneva, Switzerland, in the Vidy bay about 1.3 km offshore, to investigate the fine-scale mixing phenomenon of the metalimnion and near seasonal thermocline. Current meters were placed between a depth of 5.0 and 20.0 m spaced 2.5 m apart. The observed mean currents showed a pattern of Ekman spiraling during E-going phases while the more dominant W-going ones oriented along the coast did not show any particular profile. There were two strong bise episodes in Sep. 1988. The time series analyses of temperatures of currents highlighted Poincare type internal wave activity. During strong north east oriented wind (bise) episodes the wave amplitude was strongly increased. Richardson number series pointed to mixing activity as a consequence of the second bise. ESA

N90-25289*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF VANE TWIST ON THE PERFORMANCE OF DOME SWIRLERS FOR GAS TURBINE AIRBLAST ATOMIZERS
Gerald J. Micklow, Anju S. Dogra (Florida Univ., Gainesville.), and H. Lee Nguyen Jun. 1990 15 p Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; sponsored in part by AIAA, SAE, ASME, and ASEE Original contains color illustrations
(NASA-TM-103195; E-5589; NAS 1.15:103195; AIAA-90-1955)
Avail: NTIS HC A03/MF A01; 1 functional color page CSCL 20D

For advanced gas turbine engines, two combustor systems, the lean premixed/prevaporized (LPP) and the rich burn/quick quench/lean burn (RQL) offer great potential for reducing NO(x) emissions. An important consideration for either concept is the development of an advanced fuel injection system that will provide a stable, efficient, and very uniform combustion system over a wide operating range. High-shear airblast fuel injectors for gas turbine combustors have exhibited superior atomization and mixing compared with pressure-atomizing fuel injectors. This improved mixing has lowered NO(x) emissions and the pattern factor, and has enabled combustors to alternate fuels while maintaining a stable, efficient combustion system. The performance of high-shear airblast fuel injectors is highly dependent on the design of the dome swirl vanes. The type of swirl vanes most widely used in gas turbine combustors are usually flat for ease of manufacture, but vanes with curvature will, in general, give superior aerodynamic performance. The design and performance of high-turning, low-loss curved dome swirl vanes with twist along the span are investigated. The twist induces a secondary vortex flow pattern which will improve the atomization of the fuel, thereby producing a more uniform fuel-air distribution. This uniform distribution will increase combustion efficiency while lowering NO(x) emissions. A systematic swirl vane design system is presented based on one-, two-, and three-dimensional flowfield calculations, with variations in vane-turning angle, rate of turning, vane solidity, and vane twist as design parameters. Author

N90-25290*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EQUILIBRIUM RADIATIVE HEATING TABLES FOR AEROBRAKING IN THE MARTIAN ATMOSPHERE
Lin C. Hartung, Kenneth Sutton, and Frank Brauns (North Carolina State Univ., Raleigh.) May 1990 20 p
(NASA-TM-102659; NAS 1.15:102659) Avail: NTIS HC A03/MF A01 CSCL 20D

Studies currently underway for Mars missions often envision the use of aerobraking for orbital capture at Mars. These missions generally involve blunt-nosed vehicles to dissipate the excess energy of the interplanetary transfer. Radiative heating may be of importance in these blunt-body flows because of the highly energetic shock layer around the blunt nose. In addition, the Martian atmosphere contains CO2, whose dissociation products are known to include strong radiators. An inviscid, equilibrium, stagnation point, radiation-coupled flow-field code has been developed for investigating blunt-body atmospheric entry. The method has been compared with ground-based and flight data for air, and reasonable agreement has been found. In the present work, the method was applied to a matrix of conditions in the Martian atmosphere. These conditions encompass most trajectories of interest for Mars exploration spacecraft. The predicted equilibrium radiative heating to the stagnation point of the vehicle is presented. Author

N90-25291*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
A COMPUTATIONAL EFFICIENT MODELLING OF LAMINAR SEPARATION BUBBLES Final Report
Paolo Dini and Mark D. Maughmer Jul. 1990 167 p
(Grant NAG1-778)
(NASA-CR-186729; NAS 1.26:186729) Avail: NTIS HC A08/MF A01 CSCL 20D

In predicting the aerodynamic characteristics of airfoils operating at low Reynolds numbers, it is often important to account for the effects of laminar (transitional) separation bubbles. Previous approaches to the modelling of this viscous phenomenon range from fast but sometimes unreliable empirical correlations for the length of the bubble and the associated increase in momentum thickness, to more accurate but significantly slower displacement-thickness iteration methods employing inverse boundary-layer formulations in the separated regions. Since the penalty in computational time associated with the more general methods is unacceptable for airfoil design applications, use of an accurate yet computationally efficient model is highly desirable. To this end, a semi-empirical bubble model was developed and

incorporated into the Eppler and Somers airfoil design and analysis program. The generality and the efficiency was achieved by successfully approximating the local viscous/inviscid interaction, the transition location, and the turbulent reattachment process within the framework of an integral boundary-layer method. Comparisons of the predicted aerodynamic characteristics with experimental measurements for several airfoils show excellent and consistent agreement for Reynolds numbers from 2,000,000 down to 100,000. Author

N90-25292*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A DIRECT-INTERFACE, FUSIBLE HEAT SINK FOR ASTRONAUT COOLING
Curtis Lomax and B. W. Webbon May 1990 15 p Presented at the SAE/ICES 20th International Conference on Environmental Systems, Williamsburg, VA, 9 Jul. 1990
(NASA-TM-102835; A-90189; NAS 1.15:102835) Avail: NTIS HC A03/MF A01 CSCL 20D

Astronaut cooling during extravehicular activity is a critical design issue in developing a portable life support system that meets the requirements of a space station mission. Some of the requirements are that the cooling device can be easily regenerable and nonventing during operation. In response to this, a direct-interface, fusible heat sink prototype with freezable quick-disconnects was developed. A proof-of-concept prototype was constructed and tested that consists of an elastic container filled with normal tap water and having two quick-disconnects embedded in a wall. These quick-disconnects are designed so that they may be frozen with the ice and yet still be joined to the cooling system, allowing an immediate flow path. The inherent difficulties in a direct-interface heat sink have been overcome, i.e., (1) establishing an initial flow path; (2) avoiding low-flow freeze-up; and (3) achieving adequate heat-transfer rates at the end of the melting process. The requirements, design, fabrication, and testing are discussed. Author

N90-25293# Wichita State Univ., KS. Inst. for Aviation Research.
A PARAMETRIC STUDY OF COUNTERFLOW HEAT EXCHANGER TRANSIENTS M.S. Thesis
John S. Ontko May 1989 86 p Sponsored in part by Army
(IAR-89-10) Avail: NTIS HC A05/MF A01

The transient response of the single-pass counterflow heat exchanger to step changes of inlet temperatures and/or flow rates is examined. Using numerical methods, the responses of three text exchangers, representing both high and low capacitance in the fluids and/or the exchanger, are calculated and the results presented in graphical form. Also included is a description of the solution methodology and its limitations. Author

N90-25294# Los Alamos National Lab., NM.
A STUDY OF NON-UNIQUENESS AND INSTABILITY FOR CONVEX MATERIALS
Burton Wendroff 1990 13 p Presented at the 3rd International Conference on Hyperbolic Problems, Uppsala, Sweden, 11-15 Jun. 1990
(Contract W-7405-eng-36)
(DE90-012060; LA-UR-90-1775; CONF-9006186-1) Avail: NTIS HC A03/MF A01

There are stability analyses of two-dimensional plane shock waves which show the existence of unstable shock fronts for some equations of state. We present numerical evidence that these unstable two-dimensional shocks are also unstable in one dimension, at least in the sense that the Lax-Friedrichs difference scheme does not have a steady asymptotic traveling wave connecting the shocked and unshocked states. When there is instability there are also multiple solutions of the Riemann problem. In the typical case of two stable solutions and one unstable one, which of the stable ones is selected seems to depend on mesh size or the initial profile. If there is a physical selection principle, Lax-Friedrichs does not obey it. DOE

N90-25295# Los Alamos National Lab., NM.
SPECTRAL TRANSPORT MODEL FOR TURBULENCE
D. C. Besnard (Centre d'Etudes de Limeil-Valenton, Villeneuve Saint-Georges, France), F. H. Harlow, R. M. Rauenzahn, and C. Zemach Jul. 1990 71 p
(Contract W-7405-eng-36)
(DE90-011265; LA-11821-MS) Avail: NTIS HC A04/MF A01

The spectrum of inhomogeneous turbulence is modeled by an approach that is not limited to regimes of large Reynolds numbers or small mean-flow strain rates. In its simplest form and applied to incompressible flow, the model depends on five phenomenological constants defining the strength of turbulence coupling to mean flow, turbulence transport in physical and wave-number space, and mixing of stress-tensor components. The implications for homogeneous turbulence are investigated in detail and found to correspond well to the conclusions from more fundamental theories. Under appropriate limiting conditions, a turbulent system described by the model will relax over time into a state of approximate spectral equilibrium, permitting a reduction to a one-point model for the system that is substantially like the familiar K--(epsilon) model. This yields estimates of the present model's parameters and points to the way to improve modeling of flows beyond the applicability of the K--(epsilon) method. DOE

N90-25296# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
MODELING AND APPLICATIONS OF TRANSPORT PHENOMENA IN POROUS MEDIA, VOLUME 1
1990 356 p Lecture series held in Rhode-Saint-Genese, Belgium, 5-9 Feb. 1990
(VKI-LS-1990-01-Vol-1; ISSN-0377-8312; ETN-90-96999) Avail: NTIS HC A16/MF A02

The application of ordinary percolation theory concepts to describe the distribution of phases during quasi-static displacement in porous media is demonstrated. Conditions for the onset of instability in displacement in homogenous porous media, particularly covering miscible and immiscible displacements, are reviewed. The heterogeneity of porous media is described using fractal geometry. Simple reaction and transport processes that lead to a change in porespace morphology are reviewed. Eight lectures on mathematical modeling of transport in porous media are presented. For individual titles, see N90-25297 through N90-25301.

N90-25297# University of Southern California, Los Angeles. Depts. of Petroleum and Chemical Engineering.
DISCRETE APPROACH: PERCOLATION THEORY
Yanis C. Yortsos *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 1 40 P (SEE N90-25296 19-34) 1990 (For primary document see N90-25296 19-34)
Avail: NTIS HC A16/MF A02

The application of ordinary percolation theory concepts to describe the distribution of phases during quasi-static displacement in porous media is shown. A network representation of the porous medium and the assumption of local capillary equilibrium are basic requirements for this approach. An additional restriction is the lack of spatial correlations. Capillary pressure and relative permeability curves are the principal results obtained. In the course of the above, effective medium theories are reviewed. ESA

N90-25298# University of Southern California, Los Angeles. Depts. of Petroleum and Chemical Engineering.
INSTABILITIES: MISCIBLE AND IMMISCIBLE FLOWS
Yanis C. Yortsos *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 1 1990 36 p (For primary document see N90-25296 19-34)
Avail: NTIS HC A16/MF A02

Conditions for the onset of instability in displacement in homogeneous porous media are reviewed. Emphasis is placed on the effects of mobility contrast, dispersion (capillary or hydrodynamic), features of base state, and flow geometry. Miscible and immiscible displacements are discussed. Differences and similarities with Hele-Shaw flows are pointed out. Possible

limitations of the continuum description are suggested. Further research called for is outlined. ESA

N90-25299# University of Southern California, Los Angeles. Depts. of Petroleum and Chemical Engineering.
HETEROGENEITY DESCRIPTION USING FRACTAL CONCEPTS
Yanis C. Yortsos *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 1 1990 36 p (For primary document see N90-25296 19-34)
Avail: NTIS HC A16/MF A02

A brief overview of basic aspects of fractal geometry is presented and arguments for its relevance to porous media are given. Three different classes of application are considered: characterization and properties of fractal pore surfaces, gradient transport over fractal objects (e.g. fracture networks), and the representation of property heterogeneity (e.g. permeability) by fractal statistics (fractional Brownian motion). ESA

N90-25300# University of Southern California, Los Angeles. Depts. of Petroleum and Chemical Engineering.
REACTION AND TRANSPORT IN POROUS MEDIA
Yanis C. Yortsos *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 1 1990 33 p (For primary document see N90-25296 19-34)
Avail: NTIS HC A16/MF A02

Simple reaction and transport processes that lead to a change in the porespace morphology are reviewed. Three representative examples are discussed, non catalytic gas-solid reactions, acidization of porous solids, and the release, transport and deposition of particulates in porous media. The use of percolation and EMT (Effective Medium Theories), the description of instabilities, and the development of discrete and rule-based models, in pore closure or pore enlargement applications, are illustrated. ESA

N90-25301# Technion - Israel Inst. of Tech., Haifa. Dept. of Civil Engineering.
CONTINUUM APPROACH AND CONTAMINANT TRANSPORT IN GROUND WATER FLOWS
J. Bear *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 1 1990 199 p Also presented at VKI Lecture Series Programme on Modelling and Application of Transport in Porous Media, Rhode-Saint-Genese, Belgium, 30 Nov. - 3 Dec. 1987 Submitted for publication (For primary document see N90-25296 19-34)
Avail: NTIS HC A16/MF A02

Eight lectures on mathematical modeling of transport in porous media are presented. A porous medium is defined, models and why they are needed are outlined, and the modeling process is discussed. The continuum approach is introduced and microscopic and macroscopic equations for the transport model are derived. Advective flux of a phase occupying the entire void space, or part of it, and in multiphase flow is considered. Boundary conditions are discussed and a model of the problems is outlined. The modeling of mass transport, at the macroscopic level, of a single fluid phase under isothermal conditions is considered. Macroscopic diffusive fluxes of mass of a component of a phase, in single and multiphase flow, and of heat, are considered. The modeling of contaminant transport is addressed. ESA

N90-25302# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
MODELING AND APPLICATIONS OF TRANSPORT PHENOMENA IN POROUS MEDIA, VOLUME 2
1990 297 p Lecture series held in Rhode-Saint-Genese, Belgium, 5-9 Feb. 1990
(VKI-LS-1990-01-Vol-2; ISSN-0377-8312; ETN-90-97000) Avail: NTIS HC A13/MF A02

Characterization of porous media is carried out at the pore level and field level. Transport phenomena in porous media are studied using an ultrasonic technique. An overview of network modeling in porous media is presented. The flow of non Newtonian fluids in porous media is considered. A validation of physical and stochastic network simulators for the study of transport properties, in particular fingering, through porous media is presented. Particle tracking methods and fractal statistics in groundwater modeling are studied. A study of boiling and dryout with reference to the modeling of the thermohydraulic behavior of a particle bed is presented. A discussion of the small length cut-off in images of viscous fingering in porous media is presented. For individual titles, see N90-25303 through N90-25311.

N90-25303# Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
CHARACTERIZATION OF POROUS MEDIA: PORE LEVEL
F. A. L. Dullien *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 2 1990 32 p (For primary document see N90-25302 19-34)
Avail: NTIS HC A13/MF A02

Characterization of porous media on the pore (microscopic) level is done for the purpose of understanding, modeling, and in some cases, controlling the behavior and the properties of the macroscopic medium. Pore size and pore size distribution are defined, and one-dimensional pore structure models are reviewed. Capillary pressure, relative permeablility and hydrodynamic dispersion simulation with the help of network models of pore structure is discussed. Pore structure determination from serial sections is outlined. ESA

N90-25304# Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
CHARACTERIZATION OF POROUS MEDIA: FIELD LEVEL
F. A. L. Dullien *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 2 1990 22 p (For primary document see N90-25302 19-34)
Avail: NTIS HC A13/MF A02

Reservoir description, which is important for the numerical simulation of oil and gas reservoirs and aquifers, is addressed. The purpose of reservoir simulation is to predict the performance of the reservoir as accurately as possible. Rock data required for reservoir characterization is described. The determination of reservoir boundaries by pressure drawdown tests is described. The measurement of porosities and permeability are outlined. The interpolation of reservoir rock data and the particular interpolation method called kriging, using geostatistics, are discussed. Additional rock data required are listed. ESA

N90-25305# Paris VI Univ. (France). Lab. d'Ultrasons.
CHARACTERIZATION OF FLUIDS IN POROUS MEDIA
Jean-Claude Bacri and Dominique Salin *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 2 1990 18 p (For primary document see N90-25302 19-34)
Avail: NTIS HC A13/MF A02

Transport phenomena in porous media are studied by one particular experimental device. Profiles obtained on the same sample by acoustics and gammagraphy are compared. The characteristic length scale of porous medium, acoustic of fluid saturated porous media, and dispersion length measurements are studied. The ultrasonic technique is shown to be a performant way of quantitatively estimating either the fraction of two miscible fluids or the saturations of immiscible fluids (water and oil) in porous media. Applications and advantages of this method are given. ESA

N90-25306# Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Petroleum Engineering.
NETWORK MODELING OF FLUID FLOW IN POROUS MEDIA
K. S. Sorbie *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 2 1990 37 p (For primary document see N90-25302 19-34)
Avail: NTIS HC A13/MF A02

An overview of network modeling of flow and transport in porous media is presented in the context of other discrete or microscopic approaches to the modeling of porous media flows. The main elements of a network model, which involve the choice of network

topology, the assumption of a pore size distribution in which the bond size can be related to a conductivity, the setting up of a pressure equation and, where necessary, the inclusion of macroscopic rules associated with one or two phase transport in the network, are explained. The network model is proposed as offering a more powerful and detailed mathematical model for porous medium flows than other discrete approaches although the computational price paid is high. ESA

N90-25307# Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Chemical Engineering.
THE FLOW OF NON NEWTONIAN FLUIDS IN POROUS MEDIA
K. S. Sorbie *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 2 1990 37 p (For primary document see N90-25302 19-34)
Avail: NTIS HC A13/MF A02

The general issue of the flow of non Newtonian fluids in porous media is considered with concentration entirely on the flow of inelastic fluids using the biopolymer, xanthan, as the main source of experimental data due to its importance in improved oil recovery operations. Experimental observations and an analysis carried out on these data were considered. The analysis was based on empirical models that combined the capillary bundle model of the porous medium with the power law model for the fluid. The success of these models was examined by an analysis using network modeling, with emphasis on methodology rather than results. ESA

N90-25308# Institut Francais du Petrole, Rueil-Malmaison.
FINGERING IN 2-D POROUS MEDIA: EXPERIMENTS, NETWORK SIMULATORS AND STATISTICAL MODELS
R. Lenormand *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 2 1990 19 p (For primary document see N90-25302 19-34)
Avail: NTIS HC A13/MF A02

A validation of physical and stochastic network simulators, for the study of transport properties through porous media, by comparison with experiments, is presented. The study was restricted to the two-dimensional case of immiscible displacements and to the case of drainage. Both simulation and experiments show the same evolution of the patterns when the capillary number is increased over a large range; from capillary fingering to viscous fingering when a very low viscosity fluid is injected, and from capillary fingering to stable displacement when a high viscosity fluid is injected. The conclusion states that the model of fluid displacement in a porous medium was validated for the case of drainage. ESA

N90-25309# Gesamthochschule, Kassel (Germany, F.R.).
PARTICLE TRACKING METHODS AND FRACTAL STATISTICS IN GROUNDWATER MODELING
Wolfgang Kinzelbach *In* VKI, Modeling and Applications of Transport Phenomena in Porous Media, Volume 2 27 P (SEE N90-25302 19-34) 1990 Sponsored by DFG (For primary document see N90-25302 19-34)
Avail: NTIS HC A13/MF A02

Standard finite difference and finite element solution methods of the pollutant transport equation require restrictive spatial discretization in order to avoid numerical dispersion and oscillations. Particle tracking methods offer a robust alternative if for reasons of calculational effort spatial discretization requirements cannot be met. The standard random walk method is discussed for the case of an ideal tracer starting out from the Fokker-Planck equation. Particle tracking can be combined with stochastic modeling of macrodispersion. It also allows the direct introduction of non-Fickian dispersion. Various approaches including the use of fractal statistics, are discussed. ESA

N90-25310# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
THERMOHYDRAULICS OF A HEAT DISSIPATING DEBRIS BED
A. Stubos and J.-M. Buchlin *In its* Modeling and Applications of Transport Phenomena in Porous Media, Volume 2 1990 78 p (For primary document see N90-25302 19-34)
Avail: NTIS HC A13/MF A02

A study of boiling and dryout in packed beds is presented with reference to the modeling of the thermohydraulic behavior of a liquid saturated, heat dissipating, unconsolidated particle bed. Parameters and trends of the dryout power with their variation are identified. A physical model is constructed which identifies the bed zones and the associated heat transfer mechanisms and equations written for single and two phase regimes of the bed assuming thermal equilibrum of the different phases. The role of capillary force is included via use of the Leverett function of the liquid saturation. Solutions for the unsteady equations are achieved by numerical implantation. The model is validated by analysis and interpretation of the European in-pile test PIRAMID-1 on the basis of numerical simulation, and comparison with other available in- and out-of-pile data. ESA

N90-25311# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
VISCOUS FINGERING IN POROUS MEDIA: A DISCUSSION OF THE SMALL LENGTH SCALE CUT-OFF
J. M. Donohue *In its* Modeling and Applications of Transport Phenomena in Porous Media, Volume 2 1990 23 p (For primary document see N90-25302 19-34)
Avail: NTIS HC A13/MF A02

The Hele-Shaw analogy to flow in porous media is discussed with reference to miscible and immiscible displacement and prediction of finger size. Basic differences between Hele-Shaw and porous media cases are reviewed. Images saved on a digital image processing system for extraction of quantitative information are given. The evolution of the pattern in viscous fingering is found to be sensitive to what is occurring at the pattern edge. Factors contributing to the cut-off size in immiscible displacement are described. ESA

N90-25312# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
STABILITY THEORY FOR METHODS TO SOLVE THE NAVIER-STOKES EQUATIONS, PART 1
Peter Wilde 24 Jan. 1989 36 p
(FFA-TN-1988-65-Pt-1; ETN-90-97039) Avail: NTIS HC A03/MF A01

A study of the stability of some numerical schemes approximating the linearized three dimensional Navier-Stokes equations is presented. A matrix is constructed which diagonalizes the linearized Navier-Stokes equations and the well-posedness of the corresponding Cauchy problem is proven. A formalism to derive explicit and implicit finite difference schemes as well as explicit and implicit finite volume schemes is developed. Stability assertions are given for the schemes derived by using this formalism. ESA

N90-25313# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
BOUNDARY CONDITIONS FOR THE NAVIER-STOKE'S EQUATIONS AT AN ARTIFICIAL BOUNDARY INTERSECTING A SOLID BOUNDARY
Bertil Gustafsson and Jan Nordstroem 7 Mar. 1990 12 p
Sponsored in part by Swedish Board for Technical Development
(Contract FMV-82260-88-203-73-001)
(FFA-TN-1990-11; ETN-90-97042) Avail: NTIS HC A03/MF A01

The problem where an artificial boundary intersects the surface of a solid body in hypersonic flow is investigated. The analysis is based on two fundamental observations. The first one is the compatibility at the corner. This means that the conditions along the wall must match the conditions along the artificial boundary such that no discontinuities are introduced. Boundary conditions with different degree of compatibility are derived and numerical experiments that confirm the analysis are performed. The second observation is that the linearization procedure, which is the basis for the construction of boundary conditions, must be carried out carefully. It is shown that if the linearization is made around a

non-smooth solution new terms enter into the coefficient matrices for the first derivatives. This leads to new characteristic velocities such that two characteristics instead of one enter the domain at an outflow boundary. ESA

N90-25314# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
THREE-DIMENSIONAL VISCOUS FLOW STRUCTURES FROM BIFURCATION OF A DEGENERATE SINGULARY WITH THREE ZERO EIGENVALUES
R. Kooij and P. G. Bakker Oct. 1989 58 p
(LR-572; ETN-90-97160) Avail: NTIS HC A04/MF A01

Three dimensional flow structures near a plane wall are investigated by considering local solutions of the continuity equation and the Navier-Stokes equations. The flow is assumed to be steady, incompressible and to satisfy the no-slip boundary conditions at the wall. The local solutions are obtained by performing series expansions near a point at the wall. The streamline patterns are described by the trajectories of a third-order system of which the singular points play a special role. The viscous flow structures near a non-hyperbolic singularity with three eigenvalues equal to zero are investigated. In order to determine the topological behavior in the vicinity of non-hyperbolic point, various techniques such as normalform theory, parameterization and partial unfoldings are used. The physical unfolding of the singularity is analyzed and the possible bifurcations leading to structurally stable flow structures are discussed. Special emphasis is given to the skin friction pattern on the wall surface. ESA

N90-25315# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
FLOW STRUCTURES AROUND NON-HYPERBOLIC SINGULARITIES ON THE WALL WITH ONE VANISHING EIGENVALUE: A DISCUSSION OF THE FLOW STRUCTURES AND THE UNFOLDINGS
M. E. M. deWinkel Apr. 1989 42 p
(LR-586; ETN-90-97161) Avail: NTIS HC A03/MF A01

The investigation of flow structures near a plane wall is continued. The flow is assumed to be steady, incompressible and it satisfies the no-slip boundary conditions on the wall. Local solutions of the continuity equation and the Navier-Stokes equations are obtained by performing series expansions near a point at the wall and these solutions are used to classify the topology of the three dimensional, steady streamline patterns near the wall. These streamline patterns are described by the trajectories of a third-order system, of which the singular points play a special role, and are distinguished in hyperbolic and non-hyperbolic singularities. The non-hyperbolic singularities with one eigenvalue having a vanishing real part are considered. The pressure gradient normal to the wall is of crucial importance. After determining the flow structures for particular cases, bifurcation theory is used to find the physical unfoldings of the degenerate singularities. These unfoldings are used to discuss some separated flow structures. Critical remarks on the definitions of open separation as given by Wang and by Wu, Gu and Wu are presented. ESA

N90-25316# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
NOTES ON THE UNSTEADY RECTILINEAR MOTION OF A PERFECT GAS
J. A. Steketee Apr. 1989 55 p
(LR-590; ETN-90-97163) Avail: NTIS HC A04/MF A01

Explicit answers are constructed for an expansion problem concerning a straight tube of constant cross section, where the tube is closed at a point, a uniform gas is at rest, and a membrane or piston closing off a segment from a section where a vacuum reigns is suddenly removed allowing the gas to expand into the vacuum. The flow which develops is divided into two stages including a complex stage called general wave which is initiated when the first sound wave traveling into the gas is reflected from the closed end. An integration method of Riemann can be used to solve the general wave problem. Another method of general solutions is constructed. ESA

N90-25317# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
SURFACE DILATION AND FLUID-DYNAMICAL BEHAVIOUR OF NEWTONIAN LIQUIDS IN AN OVERFLOWING CYLINDER. 1: PURE LIQUIDS
D. J. Bergink-Martens, H. J. Bos, A. Prins, and B. C. Schulte (Wageningen Agricultural Univ., Netherlands) Aug. 1989 22 p
(LR-601; ETN-90-97167) Avail: NTIS HC A03/MF A01

The surface dilational viscosity relates the surface tension under dynamical conditions to the relative surface expansion rate. The value of this viscosity can be determined by means of the overflowing cylinder technique. The dynamic surface tension is determined by the Wilhelmy plate technique. The key problem is to find the relation between the surface expansion rate and the flow field developed in the cylinder for a particular surface active liquid. Calculated surface velocity distributions and surface expansion rates are compared to experimental results for a pure liquid. Some experimental results show the large influence of the addition of surfactants on the surface expansion rate. ESA

N90-25318# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
EXPERIMENTAL INVESTIGATION OF TOLLMEIN-SCHLICHTING INSTABILITY AND TRANSITION IN SIMILAR BOUNDARY LAYER FLOW IN AN ADVERSE PRESSURE GRADIENT (HARTREE BETA = -0.14)
F. J. M. Wubben 1980 150 p Sponsored in part by NLR
(LR-604; ETN-90-97170) Avail: NTIS HC A07/MF A01

The results of a two dimensional experimental investigation of the region of validity of linear stability theory in boundary layer flow, under natural disturbance conditions are presented. Experimental results are compared with two quasi-parallel linear stability computer programs. The experimental investigations were performed at a low speed laboratory on the 2m long flat test wall of a small open ended boundary layer wind tunnel with a flexible opposite wall to generate a desired pressure gradient. Except for a short initial pressure region, the pressure distribution corresponded to a Hartree = -0.14 flow. Measurements were performed with a single hot wire probe and spectral analysis was applied to present the frequency dependent evolution of perturbations in streamwise direction. ESA

N90-25086# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
NSFLEX: AN IMPLICIT RELAXATION METHOD FOR THE NAVIER-STOKES EQUATIONS FOR A WIDE RANGE OF MACH NUMBERS
Manfred A. Schmatz *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 77-84 Presented at the 5th GAMM-Seminar on Numerical Treatment of the Navier-Stokes Equations, Kiel, Fed. Republic of Germany, 20-22 Jan. 1989 (For primary document see N90-25075 19-01)
(MBB-FE-122/S/PUB-366) Avail: NTIS HC A15/MF A02

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N90-25319*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A LINEARLY CONTROLLED DIRECT-CURRENT POWER SOURCE FOR HIGH-CURRENT INDUCTIVE LOADS IN A MAGNETIC SUSPENSION WIND TUNNEL
John S. Tripp and Taumi S. Daniels Washington Aug. 1990

24 p
(NASA-TM-4198; L-16717; NAS 1.15:4198) Avail: NTIS HC A03/MF A01 CSCL 14B

The NASA Langley 6 inch magnetic suspension and balance system (MSBS) requires an independently controlled bidirectional DC power source for each of six positioning electromagnets. These electromagnets provide five-degree-of-freedom control over a suspended aerodynamic test model. Existing power equipment, which employs resistance coupled thyratron controlled rectifiers as well as AC to DC motor generator converters, is obsolete, inefficient, and unreliable. A replacement six phase bidirectional controlled bridge rectifier is proposed, which employs power MOSFET switches sequenced by hybrid analog/digital circuits. Full load efficiency is 80 percent compared to 25 percent for the resistance coupled thyratron system. Current feedback provides high control linearity, adjustable current limiting, and current overload protection. A quenching circuit suppresses inductive voltage impulses. It is shown that 20 kHz interference from positioning magnet power into MSBS electromagnetic model position sensors results predominantly from capacitively coupled electric fields. Hence, proper shielding and grounding techniques are necessary. Inductively coupled magnetic interference is negligible. Author

N90-25320# State Univ. of New York, Albany. Mechanical Systems Lab.
CONTROL STRUCTURE INTERACTION INSTRUMENTATION Final Technical Report, 1 Dec. 1988 - 30 Nov. 1989
Daniel J. Inman 1 Mar. 1990 9 p
(Grant AF-AFOSR-0143-89; AF Proj. 3842)
(AD-A221375; AFOSR-90-0450TR) Avail: NTIS HC A02/MF A01 CSCL 13/11

This instrumentation award funded the purchase of a strain gauge instrumentation system, piezoelectric actuator system, a pneumatic thruster control system and a digital AD/DA controller system (Systolic System, Inc., Optima 3 nonlinear robotics controller) for use in experiments in identification and control of flexible structures modeled by partial differential equations. This equipment, combined with existing vibration suppression, slewing control and testing facilities provides a unique identification and control facility for flexible structures. The piezoelectric devices combined with existing electric motors, proof mass actuators and accelerometers provide an excellent facility for examining the theory related to active structures. In particular, experiments have been designed and initial testing begun on vibration suppression during slewing control of an active truss. GRA

N90-25321# Department of the Navy, Washington, DC.
INFRARED FIBER-OPTICAL TEMPERATURE SENSOR Patent Application
James E. Bryant, inventor (to Navy), John E. Bennett, inventor (to Navy), and William H. Pinkston, inventor (to Navy) 23 Mar. 1990 17 p
(AD-D014519; US-Patent-Appl-SN-501996) Avail: NTIS HC A03/MF A01 CSCL 17/5

A temperature sensor comprising a probe, infrared fibers, super cooled detectors and their associated electronics, and a computer for determining the temperature from the output of the electronics are disclosed. Photons from a heat source are collected by the infrared fibers and transmitted to the detectors amplifier unit where they are detected and amplified by the electronics. A voltage is then outputted which represents measured temperature. The voltage is sampled by the computer where it is converted to temperature by use of computer algorithms. GRA

N90-25322# Federal Aviation Administration, Atlantic City, NJ.
COMPARISON TEST OF DROPLET SIZING INSTRUMENTS USED IN ICING RESEARCH
James T. Riley Apr. 1990 136 p
(DOT/FAA/CT-TN90/13) Avail: NTIS HC A07/MF A01

A comparison test of droplet sizing instruments used in icing research was conducted at the Arnold Engineering Development Center (AEDC) at Arnold Air Force Base, Tennessee in May 1988. Included in the test were the fiber optics system particle-sizer used at AEDC, a forward scattering spectrometer probe and optical array probe provided by NASA Lewis Research Center in Cleveland, Ohio, and a phase Doppler particle analyzer provided by Aerometrics, Inc. of Sunnyvale, California. The test plan encompassed systematic variation of velocity, droplet number density, droplet medium volume diameter (MVD) and droplet size distribution. The main results of the test are analyzed. Author

N90-25323*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPTICAL TECHNIQUES FOR DETERMINATION OF NORMAL SHOCK POSITION IN SUPERSONIC FLOWS FOR AEROSPACE APPLICATIONS
Grigory Adamovsky and John G. Eustace (John Carroll Univ., Cleveland, OH.) 1990 9 p Presented at the 3d Conference on Optical Testing and Metrology, San Diego, CA, 8-13 Jul. 1990; sponsored by the Society of Photo-Optical Instrumentation Engineers
(NASA-TM-103201; E-5599; NAS 1.15:103201) Avail: NTIS HC A02/MF A01 CSCL 14B

Techniques for the quantitative determination of shock position in supersonic flows using direct and indirect methods is presented. A description of an experimental setup is also presented, different configurations of shock position sensing systems are explained, and some experimental results are given. All of the methods discussed are analyzed to determine the ease of technology transfer from the laboratory to in-flight operation. Author

N90-25324*# Sverdrup Technology, Inc., Brook Park, OH.
FEASIBILITY STUDY FOR THE ADVANCED ONE-DIMENSIONAL HIGH TEMPERATURE OPTICAL STRAIN MEASUREMENT SYSTEM, PHASE 3 Final Report
Christian T. Lant Jun. 1990 21 p
(Contract NAS3-25266)
(NASA-CR-185254; E-5546; NAS 1.26:185254) Avail: NTIS HC A03/MF A01 CSCL 14B

The Instrumentation and Control Technology Division is developing optical strain measurement systems for applications using high temperature wire and fiber specimens. This feasibility study has determined that stable optical signals can be obtained from specimens at temperatures beyond 2,400 C. A system using an area array sensor is proposed to alleviate off-axis decorrelation arising from rigid body motions. A digital signal processor (DSP) is recommended to perform speckle correlations at a rate near the data acquisition rate. Design parameters are discussed, and fundamental limits on the speckle shift strain measurement technique are defined. Author

N90-25325*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A NONCONTACTING MOTION MONITORING SYSTEM FOR AN ASTRONAUT TRANSLATION AID
Tom D. Finley Apr. 1990 13 p
(NASA-TM-102640; NAS 1.15:102640) Avail: NTIS HC A03/MF A01 CSCL 14B

The development of a noncontacting motion sensing system designed to monitor the movement of a cart along a track in the low earth orbit space environment is described. The system uses Hall effect sensors to detect the position of small permanent magnets located along the track. The measurement criteria are described, the system design is discussed, and estimates of the system error are given. The system will be used on the Crew and Equipment Translation Aid (CETA) experiment scheduled for the STS37 flight in November 1990. It will allow the position, velocity, and acceleration of the cart to be determined as it moves along the track. Author

N90-25326# Wichita State Univ., KS. National Inst. for Aviation Research.
A MODIFIED UBBELOHDE VISCOMETER WITH IMPROVED DILUTION CHARACTERISTICS

Patrick J. Mann, Shao Wen, Yin Xiaonan, and William T. K. Stevenson 1990 15 p
(NIAR-90-16) Avail: NTIS HC A03/MF A01

A simple modification of the standard Ubbelohde dilution viscometer is proposed. This modification consists of replacing the commercially supplied dilution reservoir with a siphon tube leading to a much larger custom built storage container. Typically, the usual two fold dilution capability of commercial pieces can be increased to as much as ten or twelve fold without loss of accuracy. Examples are presented which illustrate how this simplifies and accelerates data acquisition for the routine measurement of polymer intrinsic viscosity, and in addition, allows for the measurement of such, using very small quantities of polymer. The former is illustrated through routine measurement of the intrinsic viscosity of a thermoplastic polyelectrolyte polymer containing 2-hydroxyethyl methacrylate and methacrylic acid; and the latter through an analysis of changes in intrinsic viscosity accompanying thermally induced chain scission in Phenoxy resin (Union Carbide, poly bisphenol A, 2-hydroxypropylether). Author

N90-25327# Ceskoslovenska Akademie Ved, Prague. Ceskoslovenska Spektroskopicka Spolecnost.
CONFERENCE ON INSTRUMENTAL ACTIVATION ANALYSIS: IAA 89
M. Vobecky, ed. and I. Obrusnik, ed. May 1989 57 p Conference held in Klucenice (Czechoslovakia), 15-19 May 1989
(DE90-615661; INIS-mf-11577; CONF-8905276) Avail: NTIS (US Sales Only) HC A04/MF A01

The proceedings contain 40 abstracts of papers all of which have been incorporated in INIS. The papers were centred on the applications of radioanalytical methods, especially on neutron activation analysis, x ray fluorescence analysis, PIXE analysis and tracer techniques in biology, medicine and metallurgy, measuring instruments including microcomputers, and data processing methods. DOE

N90-25328*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FAILURE OF THE ERBE SCANNER INSTRUMENT ABOARD NOAA 10 SPACECRAFT AND RESULTS OF FAILURE ANALYSIS
J. B. Miller, W. L. Weaver, L. P. Kopia, C. E. Howerton, M. G. Payton, and C. J. Harris (ST Systems Corp., Hampton, VA.) May 1990 27 p
(NASA-TM-102661; NAS 1.15:102661) Avail: NTIS HC A03/MF A01 CSCL 14B

The Earth Radiation Budget Experiment (ERBE) scanner instrument on the NOAA 10 spacecraft malfunctioned on May 22, 1989, after more than 4 years of in-flight operation. After the failure, all instrument operational mode commands were tested and the resulting data analyzed. Details of the tests and analysis of output data are discussed therein. The radiometric and housekeeping data appear to be valid. However, the instrument will not correctly execute operational scan mode commands or the preprogrammed calibration sequences. The data indicate the problem is the result of a failure in the internal address decoding circuitry in one of the ROM (read only memory) chips of the instrument computer. Author

N90-25329# Federal Aviation Administration, Atlantic City, NJ.
CALIBRATION TECHNIQUE FOR HEAT FLUX SENSORS USED IN FIRE EXPERIMENTS AND STANDARD FIRE TESTS Interim Report
K. Steckler, K. Tu, and W. Twilley Apr. 1990 33 p
(Contract DTFA03-88-A-00020)
(DOT/FAA/CT-89/26) Avail: NTIS HC A03/MF A01

A means for calibrating total heat flux gauges using a comparative (substitution) technique was established. An apparatus consisting of a reference radiometer, a stable infrared radiant heater capable of producing flux levels up to 3.7 W/sq cm, and a precision alignment mechanism was constructed. The reference radiometer was characterized by the Radiometric Physics Division at flux levels in the range 0.8 mW/sq cm to 0.9 W/sq cm. Its accuracy was found to be within 3 percent over this range which spans 3 orders of magnitude. As the radiometer is a highly linear thermocouple-based device having a self-calibration feature, this accuracy is expected to hold up to 4.2 W/sq cm, the upper limit of this device. Although the overall accuracy of calibrations performed in the new apparatus must still be established, it is expected to be within 3 to 5 percent. Author

N90-25330 Technische Univ., Delft (Netherlands).
A VOLTAGE CONTRAST DETECTOR WITH DOUBLE CHANNEL ENERGY ANALYZER IN A SCANNING ELECTRON MICROSCOPE Ph.D. Thesis
Luc Dubbeldam 1989 132 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie and Netherlands Technology Foundation
(ISBN-90-6275-568-2; ETN-90-96901) Copyright Avail: Delft University Press, 2628 BL Delft, Netherlands

Research was carried out on a voltage contrast detector in a scanning electron microscope. The form of the detector was investigated. Test techniques are reviewed as an introduction to the field of IC-testing. The physical background of secondary electron emission is discussed. The signal to noise ratio of voltage measurements for the spectrometer is calculated and compared with the theoretical maximum and values of conventional designs. Several voltage contrast detectors are described. The spectrometer is described and the influence of the magnetic field on the focusing properties of the primary system and the feasibility of a multiple focusing electron in a parallelizer and in the spectrometer was calculated with a ray tracing program. Experimental results are detailed. ESA

N90-25331# Helsinki Univ. of Technology, Espoo (Finland). Geodesian Lab.
ON THE CALIBRATION OF AN AUTOCOLLIMATOR-COMPARATOR GUIDE OF A VERTICAL TARGET LEVELLING ROD DIFFERING FROM THE ABBE'S PRINCIPLE Ph.D. Thesis [AUTOKOLLIMAATIO-OHJATTU, ABBE'N PERIAATTEESTA POIKKEAVA PYSTYLATTAKOMPARAATTORI JA SEN KALIBROINNISTA]
Jaakko Santala 1989 107 p In FINNISH
(ISBN-951-754-887-7; ISSN-0358-1284; ETN-90-96951) Avail: NTIS HC A06/MF A01

The study performed on the accuracy and adaptability of a vertical target levelling rod comparator is presented. An autocollimator device is applied in the system's calibration. Several studies on the differences in the length of vertical and horizontal positions of an accurate target levelling rod are reviewed. Theoretical and experimental investigations relating to error tolerances are presented. The results of calibration measurements carried out with the comparator developed are summarized. Further improvements are suggested and conclusions are given. ESA

N90-25332# European Space Agency, Paris (France).
CONSTRUCTION OF A HYBRID ANGULAR VELOCITY REFERENCE SYSTEM FOR INVESTIGATION OF THE DYNAMIC CHARACTERISTICS OF STRAPDOWN GYROS
Helmut Niederstrasser (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) May 1990 77 p Transl. into ENGLISH from Aufbau einer hybriden Drehgeschwindigkeitsreferenz zur Untersuchung des Verhaltens von Strapdownkreiseln (Brunswick, Fed. Republic of Germany, DFVLR), Dec. 1988 76 p Original language document was announced as N90-12577
(ESA-TT-1181; DFVLR-FB-89-25; ETN-90-97081) Avail: NTIS HC A05/MF A01

A hybrid angular velocity reference system for dynamic gyro investigations with conventional single-axis turntable is described. The reference measurement system consists of an inductosyn, a tachometer and a linear accelerometer. The dynamic investigation of laser gyros by calculation of the power spectral densities of the gyro measurement error and the gyro's dynamic response is addressed. The characteristics of the test rig, the inherent dynamics of the turntable and its scope for correction, are discussed. ESA

N90-25084# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensbereich Transport und Verkehrsflugzeuge.
SHORT TIME-DYNAMOMETER SYSTEM FOR SHOCK WAVE CHANNELS [KURZZEIT-KRAFTMESSSYSTEM (SFS) FUER STOSSWELLENKANAELE (LESS THAN 10 MS)]
Joseph Mertens and Klaus Koenig *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 63-68 In GERMAN Presented at DGLR-Fachausschusses Versuchswesen der Fluid- und Thermodynamik, Goettigen, Federal Republic of Germany, 1989 (For primary document see N90-25075 19-01)
(MBB-UT-115/89-PUB) Avail: NTIS HC A15/MF A02

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N90-25333# NKF Engineering, Inc., Columbia, MD. Arctic Technology Group.
FEASIBILITY OF USING LASERS AND INFRARED HEATERS AS UNREP ICING COUNTERMEASURES Final Report, Jun. - Dec. 1989
Lawrence A. Schultz and Peter V. Minnick 29 Dec. 1989 267 p
(Contract N00167-86-D-0069)
(AD-A219031; NKF-4090-001) Avail: NTIS HC A12/MF A02 CSCL 09/3

The results are summarized of a study directed toward determining the feasibility of applying laser technology to UNREP deicing, and infrared heating technology to UNREP anti-icing and deicing. The shipboard applicability of lasers for use as an UNREP deicing tool was determined to be technically feasible, with the laser system operating in either a melting mode or a shattering mode. Design approaches were developed for overcoming concerns related to the ability of the laser to remove ice without damaging the underlying surface, and the ability to use the system without risk of injury to the operator or to other members of the deicing team. GRA

N90-25334# Department of the Navy, Washington, DC.
A ROOM-TEMPERATURE, LASER DIODE-PUMPED, Q-SWITCHED, 2 MICRON, THULIUM-DOPED, SOLID STATE LASER Patent Application
Leon Esterowitz, inventor (to Navy) and Robert C. Stoneman, inventor (to Navy) 30 Mar. 1990 18 p
(AD-D014527; US-Patent-Appl-SN-501461) Avail: NTIS HC A03/MF A01 CSCL 09/3

A room-temperature, laser-pumped, Q-switched, thulium-doped, solid state laser for producing pulses of laser emission at substantially 2 microns is disclosed. In a preferred embodiment, the laser comprises: a laser cavity defined by first and second reflective path elements opposing each other on a common axis to form a reflective path there between; a laser crystal disposed in the laser cavity, the laser crystal having a host material doped with an amount of thulium activator ions sufficient to produce a laser emission at substantially 2 microns from the 3F4 to 3H6 laser transition in the thulium activator ions when the laser crystal is enabled and is pumped by a CW pump beam at a preselected wavelength; a pump laser for pumping the laser crystal with the CW pump beam at the preselected wavelength; and a Q-switch disposed in the laser cavity between the laser crystal and the second reflective element for periodically enabling the laser crystal to produce a pulsed laser emission at substantially 2 microns when the crystal is also pumped by the CW pump beam. GRA

N90-25335 Department of the Navy, Washington, DC.
NONLINEAR OPTICAL PROTECTION AGAINST FREQUENCY AGILE LASERS Patent
Vaughn P. McDowell, inventor (to Navy) 20 Mar. 1990 9 p Filed 4 Aug. 1988 Supersedes AD-D013881 (AD-D014535; US-Patent-4,909,609; US-Patent-Appl-SN-228215; US-Patent-Class-350-354) Avail: US Patent and Trademark Office CSCL 20/5

An eye protection or equipment filter device protection from laser energy is disclosed. The device may be in the form of a telescope, binoculars, goggles, or constructed as part of equipment such as image intensifiers or range designators. Optical elements focus the waist of the beam within a nonlinear frequency-doubling crystal or nonlinear optical element or fiber. The nonlinear elements produce a harmonic outside the visible spectrum in the case of crystals, or absorb the laser energy in the case of nonlinear fibers. Embodiments include protectors for the human eye as well as filters for sensitive machinery such as TV cameras, FLIR systems or other imaging equipment. GRA

N90-25336# Los Alamos National Lab., NM.
EXPANDED DAMAGE TEST FACILITIES AT LLNL
A. J. Morgan, F. Rainer, F. P. DeMarco, R. P. Gonzales, M. R. Kozlowski, and M. C. Staggs Apr. 1990 13 p Presented at the 1989 Boulder Damage Symposium, Boulder, CO, 1-3 Nov. 1989
(Contract W-7405-eng-48)
(DE90-011466; UCRL-101642; CONF-8911192-1) Avail: NTIS HC A03/MF A01

A thorough expansion of the laser-induced damage-test capabilities at LLNL is being completed which allow tests to be conducted under a variety of parameter conditions. Details of the physical configurations of the individual systems, laser sample diagnostics, and general testing procedures and capabilities are described. Damage test results are presented in a companion paper at this conference --- Laser Damage Database at 1064 nm. DOE

N90-25337# Lawrence Livermore National Lab., CA.
SPECTROSCOPY OF LASER PROPERTIES OF Nd(3+)-DOPED CaF2, SrF2, AND BaF2
Stephen A. Payne, John A. Caird, L. L. Chase, L. K. Smith, N. D. Nielsen, and William F. Krupke Mar. 1990 14 p Presented at the Optical Society of America Conference on Solid State Lasers, Salt Lake City, UT, 5-7 Mar. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE90-012086; UCRL-102247; CONF-900373-2) Avail: NTIS HC A03/MF A01

The optical properties of Nd(3+) in CaF2, SrF2, and BaF2 were investigated in order to determine if these materials are useful as laser-pumped amplifier media. The CaF2:Nd crystal was found to not be useful because the impurities tend to cluster at very low concentration, leading to the formation of nonluminescent centers. On the other hand, the Nd(3+) centers in BaF2 exhibit unacceptably low transition strengths. SrF2:Nd appears to have adequate absorption strength, and, in addition, to have a remarkably long emission lifetime of 1280 microns. A maximum doping of 0.20 atomic percent Nd(3+) can be tolerated in SrF2 without the occurrence of detrimental clustering. The peak emission cross section of SrF2:Nd is 1.7 x 10(exp -20) sq cm at 1036.5 nm. Direct measurement of the gain spectrum of SrF2:Nd(3+) reveals the presence of the F-4(sub 3/2) yields G-2(sub 9/2) excited state absorption lines, although the impact on the emission cross section is minor. DOE

N90-25338# Lawrence Livermore National Lab., CA.
FREQUENCY DOUBLED OPERATION OF A GROUND STATE DEPLETED LASER USING THE Nd(3+)(4)F(SUB 3/2)-(4)I(SUB 9/2) TRANSITION IN Y2SiO5
R. Beach, G. Albrecht, S. Mitchell, B. Comaskey, R. Solarz, William F. Krupke, C. Brandle, and G. Berkstresser (Bell Telephone Labs., Inc., Murray Hill, NJ.) Jan. 1990 15 p Presented at the International Conference on Lasers 1989, New Orleans, LA, 3-8 Dec. 1989
(Contract W-7405-eng-48)
(DE90-012089; UCRL-102764; CONF-891261-11) Avail: NTIS HC A03/MF A01

A ground state depleted (GSD) laser has been demonstrated

at 912 nm in the form of a Q-switched oscillator operating on the Nd(3+) F-4(sub 3/2) - I-4(sub 9/2) transition in Y2SiO5. Samarium scandium gallium garnet has been demonstrated effective at selectively suppressing the competing and much stronger F-4(sub 3/2) - I-4(sub 11/2) lasing transition. Efficient harmonic generation has been demonstrated using non-critically phase matched KNbO3. DOE

N90-25339# Lawrence Livermore National Lab., CA.
DEPLETION MODE PUMPING OF SOLID STATE LASERS
D. Mundinger, R. Solarz, R. Beach, G. Albrecht, and William F. Krupke Jan. 1990 10 p Presented at the International Conference on Lasers 1989, New Orleans, LA, 3-8 Dec. 1989
(Contract W-7405-eng-48)
(DE90-012090; UCRL-102765; CONF-891261-10) Avail: NTIS HC A02/MF A01

Depletion mode pumping of solid state lasers is a new concept which offers features that are of interest for many practical applications. The physical properties and mechanisms that set the design requirements are discussed; model calculations for a practical laser design are presented; and the results of recent experiments are discussed. DOE

N90-25340* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THREE-DIMENSIONAL LASER VELOCIMETER SIMULTANEITY DETECTOR Patent
James L. Brown, inventor (to NASA) 15 May 1990 17 p Filed 14 Oct. 1988
(NASA-Case-ARC-11876-1; US-Patent-4,925,297; US-Patent-Appl-SN-257593; US-Patent-Class-356-28.5; US-Patent-Class-356-28; Int-Patent-Class-G01P-3/36) Avail: US Patent and Trademark Office CSCL 20E

A three-dimensional laser Doppler velocimeter has laser optics for a first channel positioned to create a probe volume in space, and laser optics and for second and third channels, respectively, positioned to create entirely overlapping probe volumes in space. The probe volumes and overlap partially in space. The photodetector is positioned to receive light scattered by a particle present in the probe volume, while photodetectors and are positioned to receive light scattered by a particle present in the probe volume. The photodetector for the first channel is directly connected to provide a first channel analog signal to frequency measuring circuits. The first channel is therefore a primary channel for the system. Photodetectors and are respectively connected through a second channel analog signal attenuator to frequency measuring circuits and through a third channel analog signal attenuator to frequency measuring circuits. The second and third channels are secondary channels, with the second and third channels analog signal attenuators and controlled by the first channel measurement burst signal on line. The second and third channels analog signal attenuators and attenuate the second and third channels analog signals only when the measurement burst signal is false.
Official Gazette of the U.S. Patent and Trademark Office

N90-25341# Lawrence Livermore National Lab., CA.
DESIGN AND FABRICATION OF HIGH DAMAGE THRESHOLD TURNING MIRRORS FOR THE NOVA LASER
C. R. Wolfe, M. R. Kozlowski, F. T. Marchi, F. Rainer, and E. Enemark (Optical Coating Lab., Inc., Santa Rosa, CA.) 1990 26 p Presented at the SPIE's International Symposium on Optical and Optoelectronic Applied Science and Engineering and Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract W-7405-eng-48)
(DE90-012703; UCRL-102546; CONF-900756-6) Avail: NTIS HC A03/MF A01

Laser induced damage to optical components severely limits the operating fluence of high peak power lasers used for fusion research such as the Nova laser at the Lawrence Livermore National Laboratory. In particular, surfaces and optical thin films often damage at a lower fluence than bulk materials in large aperture, high quality optics. We have designed and are fabricating new 94 cm turning mirrors for Nova as part of the Precision Nova program to improve beam quality. A new design has been optimized for updated optical performance specifications including increased damage resistance. The new mirror design will operate at all turning angles required by the ten Nova beamlines. This flexibility reduces mirror inventory and fabrication cost. A process of conditioning the mirror coating has been developed that is permanent and increases the damage threshold by as much as a factor of 2 to 3 times. DOE

N90-25077# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Zentralbereich Technik.
DIODE LASER-PUMPED SOLID-STATE LASERS: A BREAKTHROUGH IN MODERN LASER TECHNOLOGY
Peter Peuser *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 15-22 Presented at Laser Focus World, Apr. 1989 (For primary document see N90-25075 19-01)
(MBB-Z-0276/89-PUB) Avail: NTIS HC A15/MF A02

N90-25100# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensbereich Energie- und Industrietechnik.
POSSIBILITIES OF Nd: YAG LASER UTILIZATION IN MEDICINE [MOEGLICHKEITEN DER ND:YAG-LASERANWENDUNG IN DER MEDIZIN]
Frank Frank *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 305-308 In GERMAN (For primary document see N90-25075 19-01)
(MBB-UE-0002/88-PUB) Avail: NTIS HC A15/MF A02

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N90-25342*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
SELF-CONTAINED ROBOTIC ARM MANIPULATOR
Jeff D. Earnest, Greg D. Louden, Paul F. Hill, Raymond J. Kleinert, Douglas H. Dean, and Julian D. Edge Mar. 1988 132 p Original contains color illustrations
(Grant NGT-21-002-800)
(NASA-CR-184925; NAS 1.26:184925; ME-4182) Avail: NTIS HC A07/MF A01; 29 functional color pages CSCL 13I

The problem facing the space exploration program is that the lunar surface must be prepared for colonization. This preparation process must be coordinated and executed from Earth. Since there is no human interaction, other than remote operations, there needs to be a way to set up and operate test equipment to check the environment. Once the construction equipment arrive on the lunar surface, this same implement must be able to repair any damaged equipment. A robotic arm type manipulator, when interfaced with SKITTER, is the solution to this problem. The design, a self-contained robotic arm manipulator (SCRAM), will be able to do repair operations, from changing a wheel on a lunar rover to salvaging useable parts from damaged equipment, as well as the placing of scientific test equipment. SCRAM will also be able to modify the construction equipment for various jobs. The design of the manipulator is analyzed and specs are given and discussed.
Author

N90-25343*# Utah State Univ., Logan. Center for Computer-Aided Design and Manufacturing.
OUT-REACH IN-SPACE TECHNOLOGY EXPERIMENTS PROGRAM: CONTROL OF FLEXIBLE ROBOT MANIPULATORS IN ZERO GRAVITY, EXPERIMENT DEFINITION PHASE Final Report, 16 Aug. 1988 - 15 Aug. 1989
Warren F. Phillips 1989 16 p
(Contract NAS8-37754)
(NASA-CR-183849; NAS 1.26:183849) Avail: NTIS HC A03/MF A01 CSCL 13I

The results obtained show that it is possible to control light-weight robots with flexible links in a manner that produces good response time and does not induce unacceptable link vibrations. However, deflections induced by gravity cause large static position errors with such a control system. For this reason, it is not possible to use this control system for controlling motion in the direction of gravity. The control system does, on the other hand, have potential for use in space. However, in-space experiments will be needed to verify its applicability to robots moving in three dimensions. Author

N90-25344*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.

HITCHING MECHANISM FOR LUNAR DUMP TRAIN

Thomas G. Hart, Peter M. Simonson, Gregory Q. Brown, Andrew S. Ring, Timothy A. Martin, and Nils C. Newman Mar. 1989 62 p

(Grant NGT-21-002-800)

(NASA-CR-183034; NAS 1.26:183034; ME-4182) Avail: NTIS HC A04/MF A01 CSCL 13I

The lunar dump hitch is a device to connect any number of the two-wheeled lunar dump trucks together into a train configuration. It consists of three major components: a flexible member, a boom, and a hitch mechanism. The flexible member is centered in a cutout of the dump bed and is designed to flex to provide the necessary articulation for the individual trucks to negotiate obstacles in the terrain. It is connected to a central pivot point and controlled by a stepping motor which serves the purpose of aligning the entire hitch mechanism for connection between two carts. The boom folds out from a recession in the side of the cart to meet a boom from another cart and define a rigid common upright position for two connected dump beds. Some variation in this alignment is available due to the deflection of the flexible member. It is sized to withstand any forces up to and including collision between carts and collision of a train. It is connected to the flexible member by a hinge. The hitch is a two piece unit with each cart having one male and one female end. It is designed to provide a rigid joint in the x-y plane while allowing motion in the x-z plane. It also provides a large target tolerance in the y direction. Together these components form a hitch which allows articulated movement between individual carts in a train. The dump train hitch fully retracts so as not to interfere with normal operation of the trucks alone. It is easily deployed by a simple spin maneuver and can align itself for the connection procedure. Author

N90-25345*# Texas Univ., Austin. Dept. of Mechanical Engineering.

DESIGN OF A VERSATILE, TELEOPERABLE, TOWABLE LIFTING MACHINE WITH ROBOTIC CAPABILITIES FOR USE IN NASA'S LUNAR BASE OPERATIONS

Elizabeth Harris, James Ogle, and Dean Schoppe 1989 108 p

(Contract NASw-4435)

(NASA-CR-186688; NAS 1.26:186688) Avail: NTIS HC A06/MF A01 CSCL 13I

The lifting machine will assist in lifting cargo off of landers sent to the Moon and in the construction of a lunar base. Three possible designs were considered for the overall configuration of the lifting machine: the variable angle crane, the tower crane, and the gantry crane. Alternate designs were developed for the major components of the lifting machine. A teleoperable, variable angle crane was chosen as its final design. The design consists of a telescoping boom mounted to a chassis that is supported by two conical wheels for towing and four outriggers for stability. Attached to the end of the boom is a seven degree of freedom robot arm for light, dexterous, lifting operations. A cable and hook suspends from the end of the boom for heavy, gross, lifting operations. Approximate structural sizes were determined for the lifter and its components. However, further analysis is needed to determine the optimum design dimensions. The design team also constructed a model of the design which demonstrates its features and operating principals. Author

N90-25346 Department of the Navy, Washington, DC.

FABRICATION OF LOW FREQUENCY STRUCTUREBORNE VIBRATION ISOLATION MOUNT Patent

Valentino N. Fazi, Jr., inventor (to Navy), Ronald G. Murdock, inventor (to Navy), Ernest O. Hancock, inventor (to Navy), and John W. McCready, inventor (to Navy) 20 Mar. 1990 4 p Filed 28 Nov. 1988

(AD-D014532; US-Patent-4,908,929; US-Patent-Appl-SN-276987; US-Patent-Class-29-525.1) Avail: US Patent and Trademark Office CSCL 13/9

A low frequency structureborne vibration isolation mount is described. It includes an annular disk pad for vibration damping material which is sandwiched and bonded between two similar light but rugged annular disks. The annular disk pad and the two annular disks have equal number of matching and corresponding holes along the circumferences thereof. The sizes of the holes are so chosen that one of the annular disks can be secured to the moving piece of equipment and isolated from everything else and the other annular disk can be secured to the stationary piece of equipment. The vibrations of the moving piece of equipment are thus isolated from everything else. GRA

N90-25347# Oak Ridge National Lab., TN. Metals and Ceramics Div.

ADVANCED TECHNOLOGY IN WELDING, MATERIALS PROCESSING AND EVALUATION

A. J. Moorhead 10 May 1990 25 p Presented at the 5th International Symposium of the Japan Welding Society, Tokyo, Japan, 17-19 Apr. 1990

(Contract DE-AC05-84OR-21400)

(DE90-010799; ORNL/FTR-3605) Avail: NTIS HC A03/MF A01

Topics addressed included: laser material processing; microjoining; welding advances with computers; robotization; and the physics of welding processes. Author

N90-25348# Wichita State Univ., KS. Dept. of Mechanical Engineering.

A SIMULATION CODE FOR TURBOCOMPOUND DIESEL ENGINES Final Report

James A. Harris and Ali M. Youssef Nov. 1989 134 p

(IAR-89-26) Avail: NTIS HC A07/MF A01

A FORTRAN computer code was developed to simulate the performance of a turbocompound two-stroke diesel engine. This powerplant offers the potential for fuel efficiency combined with high power-to-weight ratio, and is being considered for airborne applications such as helicopters and drone aircraft. The simulation code allows the user to specify engine parameters for the diesel core, the turbocharger (in the form of a performance curve), the bottoming turbine, and the intercooler. The program runs in two modes. The user runs the design mode first, in which specification parameters are set and the code sizes the turbomachinery and intercooler. The off-design mode can then be run to see how the resulting engine will perform at off-design values of ambient conditions, fueling rate, and engine speed. The code was developed to run on a IBM PC. Graphical interface programs allow the user to input parameters on a screen showing the engine schematic, and to display the simulated performance in various graphical formats. Author

N90-25349*# Wichita State Univ., KS. National Inst. for Aviation Research.

HEAT SINK EFFECTS ON WELD BEAD: VPPA PROCESS

Paul O. Steranka, Jr. 1990 35 p Presented at the NASA/ASEE Summer Faculty Fellowship Program, Huntsville, AL, 28 Jun. 1989 Previously announced as N90-19418

(Grant NGT-01-008-021)

(NASA-CR-186723; NAS 1.26:186723; NIAR-90-8) Avail: NTIS HC A03/MF A01 CSCL 13H

An investigation into the heat sink effects due to weldment irregularities and fixtures used in the variable polarity plasma arc (VPPA) process was conducted. A basic two-dimensional model was created to represent the net heat sink effect of surplus material

using Duhamel's theorem to superpose the effects of an infinite number of line heat sinks of variable strength. Parameters were identified that influence the importance of heat sink effects. A characteristic length, proportional to the thermal diffusivity of the weldment material divided by the weld torch travel rate, correlated with heat sinking observations. Four tests were performed on 2219-T87 aluminum plates to which blocks of excess material were mounted in order to demonstrate heat sink effects. Although the basic model overpredicted these effects, it correctly indicated the trends shown in the experimental study and is judged worth further refinement. Author

N90-25350# Sandia National Labs., Albuquerque, NM.
PERFORMANCE OF A SELF-ALIGNING SOLAR ARRAY TRACKING CONTROLLER
Alexander B. Maish 1990 7 p Presented at the 21st IEEE Photovoltaic Specialists Conference, Kissimmee, FL, 21-25 May 1990
(Contract DE-AC04-76DP-00789)
(DE90-011184; SAND-89-2571C; CONF-900542-2) Avail: NTIS HC A02/MF A01

Sandia's advanced SolarTrak control system provides sun tracking, night and emergency stow, communication, and manual drive control functions for one- and two-axis solar trackers in a low-cost, user-friendly package. This paper describes the hardware design features and sophisticated control algorithms, such as a 6-degree self-alignment routine and a self-adjusting motor actuation time, that enhance SolarTrak's pointing accuracy and system reliability while at the same time reducing operation and maintenance requirements. Performance measurements taken on operating systems over the past year show full-day pointing accuracies better than + or - 0.1 degree have been achieved. Sandia plans to provide non-exclusive licenses for the technology. DOE

N90-25351# Oak Ridge National Lab., TN. Metals and Ceramics Div.
WEAR TRANSITION SURFACES FOR LONG-TERM WEAR EFFECTS
Charles S. Yust 1990 13 p Presented at the Symposium on Tribological Modeling for Mechanical Designers, San Francisco, CA, 23 May 1990
(Contract DE-AC05-84OR-21400)
(DE90-011314; CONF-9005192-1) Avail: NTIS HC A03/MF A01

Tribologists tend to present friction and wear data as tabulations of values for specific ranges of test conditions. The conditions generally involve short test durations and express system loads in terms of applied forces. The designer, on the other hand, is concerned with stress levels and component durability, in particular time to failure. Because machine components are frequently exposed to cyclic stress conditions, fatigue effects cannot be ignored, especially in non-metallic materials containing residual flaw populations. Wear maps and transition diagrams are emerging as a convenient means of summarizing and presenting wear data in a form useful to designers. An extension of one of the diagrams to incorporate the effects if time on wear response is proposed and discussed. DOE

N90-25352*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
ROBOT VIBRATION CONTROL USING INERTIAL DAMPING FORCES
Soo Han Lee and Wayne J. Book [1989] 8 p
(Grant NAG1-623)
(NASA-CR-186808; NAS 1.26:186808) Avail: NTIS HC A02/MF A01 CSCL 13I

The suppression is examined of the vibration of a large flexible robot by inertial forces of a small robot which is located at the tip of the large robot. A controller for generating damping forces to a large robot is designed based on the two time scale mode. The controller does not need to calculate the quasi-steady state variables and is efficient in computation. Simulation results show the effectiveness of the inertial forces and the controller designed. Author

N90-25353*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
UNITED STATES PLANETARY ROVER STATUS: 1989
Donna L. S. Pivirotto and William C. Dias 15 May 1990 114 p
(Contract NAS7-918)
(NASA-CR-186843; NAS 1.26:186843; JPL-Publ-90-6) Avail: NTIS HC A06/MF A01 CSCL 13I

A spectrum of concepts for planetary rovers and rover missions, is covered. Rovers studied range from tiny micro rovers to large and highly automated vehicles capable of traveling hundreds of kilometers and performing complex tasks. Rover concepts are addressed both for the Moon and Mars, including a Lunar/Mars common rover capable of supporting either program with relatively small modifications. Mission requirements considered include both Science and Human Exploration. Studies include a range of autonomy in rovers, from interactive teleoperated systems to those requiring and onboard System Executive making very high level decisions. Both high and low technology rover options are addressed. Subsystems are described for a representative selection of these rovers, including: Mobility, Sample Acquisition, Science, Vehicle Control, Thermal Control, Local Navigation, Computation and Communications. System descriptions of rover concepts include diagrams, technology levels, system characteristics, and performance measurement in terms of distance covered, samples collected, and area surveyed for specific representative missions. Rover development schedules and costs are addressed for Lunar and Mars exploration initiatives. Author

N90-25354# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
ENGINEERING EVALUATION TESTING OF THE SOLEQ DUAL BATTERY VAN
R. D. MacDowall and A. F. Burke Jun. 1990 115 p
(Contract DE-AC07-76ID-01570)
(DE90-012685; DOE/ID-10262) Avail: NTIS HC A06/MF A01

This report presents the results of engineering evaluation testing of the Soleq Dual Battery Van, which is full-size Dodge van retrofitted with a DC electric powertrain developed by Soleq Corporation of Chicago, Illinois. The purpose of the testing was to quantify the performance and energy utilization of the Dual Battery Van, as outlined in the Society of Automotive Engineers (SAE J227) Electric Vehicle Test Procedure, and to provide a comparison with other electric vehicles of similar size and weight under equivalent conditions. DOE

N90-25549*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
IMPACT OF END EFFECTOR TECHNOLOGY ON TELEMANIPULATION PERFORMANCE
A. K. Bejczy, Z. Szakaly, and T. Ohm *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 429-440 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 13I

N90-25550*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SMART HANDS FOR THE EVA RETRIEVER
Clifford W. Hess and Larry C. Li *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 441-446 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 13I

N90-25551*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
KINEMATICALLY REDUNDANT ARM FORMULATIONS FOR COORDINATED MULTIPLE ARM IMPLEMENTATIONS
Robert W. Bailey, Leslie J. Quiocho (LinCom Corp., Houston, TX.),

and Timothy F. Cleghorn *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 447-454 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 13I

N90-25572*# Wisconsin Univ., Madison. Center for Space Automation and Robotics.
TEST BED EXPERIMENTS FOR VARIOUS TELEROBOTIC SYSTEM CHARACTERISTICS AND CONFIGURATIONS
Neil A. Duffie, Steven F. Wiker, and John J. Zik *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 637-644 (For primary document see N90-25503 19-59)
(Grant NAGw-975)
Avail: NTIS HC A99/MF A04 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N90-25355*# Washington Univ., Saint Louis, MO. Dept. of Physics.
AN APPROACH FOR RELATING THE RESULTS OF QUANTITATIVE NONDESTRUCTIVE EVALUATION TO INTRINSIC PROPERTIES OF HIGH-PERFORMANCE MATERIALS Semiannual Progress Report, 15 Sep. 1989 - 14 Mar. 1990
James G. Miller Mar. 1990 33 p
(Grant NsG-1601)
(NASA-CR-186484; NAS 1.26:186484) Avail: NTIS HC A03/MF A01 CSCL 14D

One of the most difficult problems the manufacturing community has faced during recent years has been to accurately assess the physical state of anisotropic high-performance materials by nondestructive means. In order to advance the design of ultrasonic nondestructive testing systems, a more fundamental understanding of how ultrasonic waves travel and interact within the anisotropic material is needed. The relationship between the ultrasonic and engineering parameters needs to be explored to understand their mutual dependence. One common denominator is provided by the elastic constants. The preparation of specific graphite/epoxy samples to be used in the experimental investigation of the anisotropic properties (through the measurement of the elastic stiffness constants) is discussed. Accurate measurements of these constants will depend upon knowledge of refraction effects as well as the direction of group velocity propagation. The continuing effort for the development of improved visualization techniques for physical parameters is discussed. Group velocity images are presented and discussed. In order to fully understand the relationship between the ultrasonic and the common engineering parameters, the physical interpretation of the linear elastic coefficients (the quantities that relate applied stresses to resulting strains) are discussed. This discussion builds a more intuitional understanding of how the ultrasonic parameters are related to the traditional engineering parameters. Author

N90-25356# Ames Lab., IA.
NONDESTRUCTIVE X RAY METHODS FOR CHARACTERIZATION OF ADVANCED AEROSPACE MATERIALS M.S. Thesis - Iowa State Univ.
Bruce Edward Shull Feb. 1990 80 p
(Contract W-7405-eng-82)
(DE90-011751; IS-T-1435) Avail: NTIS HC A05/MF A01

The purpose of this thesis is to develop an automated x ray technique for characterizing aerospace materials using a new digital detector. This technique can be used for process monitoring, material composition measurement, characterizing defects and monitoring these defects while in-service. The inspection method summarized in this thesis is tested on several advanced composites and ceramics to determine its suitability to quantify the porosity and or particle reinforcement content as well as variations due to heat treatment processing. The energy and material dependent interaction of x rays with materials make it a natural tool for material characterization. The sensitivity to material variations is enhanced considerably, over film, with the use of a digital detector. This, when added to the high spatial resolution obtained by using a detector collimator, makes the digital detector a powerful feature mapping tool. DOE

N90-25357# Technical Research Centre of Finland, Espoo. Metals Lab.
EDDY CURRENT INSPECTION AT THE NUCLEAR POWER PLANTS
Kari Lahdenpera Sep. 1989 93 p In FINNISH; ENGLISH SUMMARY Sponsored by Finnish Center for Radiation and Nuclear Safety
(VTT-RR-653; ISBN-951-38-3535-9; ISSN-0358-5077; ETN-90-96994) Copyright Avail: NTIS HC A05/MF A01

Possibilities for eddy current testing in nuclear power plants are discussed. The research presented is based on the literature and the experience of the Metals Laboratory of the Technical Research Center of Finland working on inservice inspections of nuclear power plants. Emphasis is given to eddy current testing of heat exchangers and especially of steam generators. Descriptions of typical degradation mechanisms and recommended methods to detect and evaluate such degradations are included. The application of the eddy current method to surface testing, particularly to the testing of turbine blades and threated components is considered. Special attention is given to the sensitivity and the restrictions of eddy current testing due to material properties and geometry. ESA

N90-25358# Technical Research Centre of Finland, Espoo. Metals Lab.
INSPECTION OF WELDS WITH EDDY CURRENT
Kari Lahdenpera Oct. 1989 37 p In FINNISH; ENGLISH summary
(VTT-RR-644; ISBN-951-38-3606-1; ISSN-0358-5077; ETN-90-97089) Copyright Avail: NTIS HC A03/MF A01; Government Printing Center, P.O. Box 516, SF-00101 Helsinki, Finland, HC 40 Finnish marks

The application of eddy current inspection to the testing of welds in ferritic steel structures is studied. All artificial EDM notches exceeding 6 mn were found. More than half of 3 mn notches were found. Eddy current method was used to detect and evaluate natural defects. All specimens were tested with magnetic particle method. Results from eddy current and magnetic particle inspection are compared. With long cracks (10 mm) the results were comparable. With shorter cracks the magnetic particle method was more sensitive than eddy current method. ESA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N90-25359*# Texas A&M Univ., College Station. Mechanics and Materials Center.
EXPERIMENTAL OBSERVATIONS AND FINITE ELEMENT ANALYSIS OF THE INITIATION OF FIBER MICROBUCKLING IN NOTCHED COMPOSITE LAMINATES Annual Progress Report
E. Gail Guynn and Walter L. Bradley 20 Dec. 1989 190 p
(Grant NAG1-659)
(NASA-CR-186207; NAS 1.26:186207) Avail: NTIS HC A09/MF A01 CSCL 20K

An understanding was developed of the factors that determine

the semi-circular edge-notched compressive strength and the associated failure mode(s) were identified of thermoplastic composite laminates with multidirectional stacking sequences. The experimental observations and the detailed literature review suggest at least four factors that affected the determination of the strain levels at which fiber microbuckling initiates and thus, partially control the composite's compression strength. The dependent variables studied are the compressive strength of a reduced gage section compression specimen and the compression strength of a compression specimen with two semi-circular edge notches (no opposite free edges) centered along the gage section. In this research, specimens containing two semi-circular edge notches (no opposite free edges) were loaded in compression at a relatively slow rate to provide more stable development of fiber microbuckling damage. The results indicate that the local constraints (free surfaces, supporting ply orientation, and resin-rich regions) significantly affect the strain level for the initiation of in-plane fiber microbuckling. Preliminary results at an elevated temperature, 77 C, showed the shear stress yield strength of the resin was reduced and consequently, the resistance to fiber microbuckling was also reduced. The finite element analysis of the perfectly straight fiber problem indicates that the free surface effect causes a 10 percent reduction in the critical buckling strain. However, the experimentally measured reduction for fibers with an initial fiber curvature, was 35 percent. Author

N90-25360*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

COMPARISON OF TWO COMPUTER CODES FOR CRACK GROWTH ANALYSIS: NASCRAC VERSUS NASA/FLAGRO

R. Stallworth, C. A. Meyers, and H. C. Stinson Dec. 1989 28 p

(NASA-TM-100383; NAS 1.15:100383) Avail: NTIS HC A03/MF A01 CSCL 20K

Results are presented from the comparison study of two computer codes for crack growth analysis - NASCRAC and NASA/FLAGRO. The two computer codes gave compatible conservative results when the part through crack analysis solutions were analyzed versus experimental test data. Results showed good correlation between the codes for the through crack at a lug solution. For the through crack at a lug solution, NASA/FLAGRO gave the most conservative results. Author

N90-25361# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.

STUDY ON APPLICATION OF ULTRASONIC WAVE MEASUREMENT TO CREEP-FATIGUE DAMAGE DETECTION

Masaaki Matsubara and Akito Nita Sep. 1988 30 p In JAPANESE; ENGLISH summary

(DE89-782317; CRIE-T-87046) Avail: NTIS (US Sales Only) HC A03/MF A01

Research was made to extend the lives of old thermal power plants. In order to grasp the secular deterioration situation by nondestructive technique, which is an important study item, possibility of detecting creep fatigue damage by applying ultrasonic wave measurement was studied. From reference survey, it was found that ultrasonic wave measurement might be effective for the detection of damages. But it was clear that it had never been applied to the detection of creep fatigue damages which are frequent in real rotors. By connecting a usual ultrasonic wave measuring system and a microcomputer, processing of spectrum analysis by Fourier transform was made possible. Imagining the actual stop-inspection restarting of plants, a creep fatigue monitoring sham test was carried out on the CrMoV forged steel collected from a real rotor. The ultrasonic wave velocity, and the relation between the attenuation constant and the life specific consumption were obtained by this test. In this way, possibility to detect creep fatigue damages by ultrasonic wave measurment became promising. DOE

N90-25362# Finnish Academy of Technology, Helsinki.

GENERATION OF AN AXISYMMETRIC CYLINDRICAL SHELL ELEMENT USING A SHOOTING METHOD

Pentti Tuominen (Oulu Univ., Finland) 1989 54 p Sponsored by Tekniikan Edistaamissaeaetioe Foundation

(Acta-Polytec-Scand-Ci-93; ISBN-951-666-287-0; ISSN-0355-2705; ETN-90-96567) Avail: NTIS HC A04/MF A01

A finite difference shooting method is considered. The method is used to generate axisymmetric shell finite elements. The method is first described generally in connection with axially symmetric thin surface elements. Secondly, a cylindrical shell element is formed. Properties of the method are considered using numerical examples. Results are compared with analytical ones. Some conclusions concerning the use of the method are drawn. A brief consideration of the differences in results obtained by approximate and complete Fluegge equations for a cylindrical shell is made. ESA

N90-25363*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

POSTBUCKLING RESPONSE OF LONG THICK PLATES LOADED IN COMPRESSION INCLUDING HIGHER ORDER TRANSVERSE SHEARING EFFECTS

Manuel Stein, P. Daniel Sydow, and Liviu Librescu (Virginia Polytechnic Inst. and State Univ., Blacksburg.) May 1990 30 p

(NASA-TM-102663; NAS 1.15:102663) Avail: NTIS HC A03/MF A01 CSCL 20K

Buckling and postbuckling results are presented for compression-loaded simply-supported aluminum plates and composite plates with a symmetric lay-up of thin + or - 45 deg plies composed of many layers. Buckling results for aluminum plates of finite length are given for various length-to-width ratios. Asymptotes to the curves based on buckling results give N(sub xcr) for plates of infinite length. Postbuckling results for plates with transverse shearing flexibility are compared to results from classical theory for various width-to-thickness ratios. Characteristic curves indicating the average longitudinal direct stress resultant as a function of the applied displacements are calculated based on four different theories: Classical von Karman theory using the Kirchoff assumptions, first-order shear deformation theory, higher-order shear deformation theory, and 3-D flexibility theory. Present results indicate that the 3-D flexibility theory gives the lowest buckling loads. The higher-order shear deformation theory has fewer unknowns than the 3-D flexibility theory but does not take into account through-the-thickness effects. The figures presented show that small differences occur in the average longitudinal direct stress resultants from the four theories that are functions of applied end-shortening displacement. Author

N90-25364*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.

INNOVATIVE DESIGN OF COMPOSITE STRUCTURES: AXISYMMETRIC DEFORMATIONS OF UNSYMMETRICALLY LAMINATED CYLINDERS LOADED IN AXIAL COMPRESSION

Semiannual Report, 16 Aug. 1989 - 15 Feb. 1990

M. W. Hyer and P. J. Paraska Jun. 1990 118 p (Grant NAG1-665)

(NASA-CR-186635; NAS 1.26:186635; VPI-E-90-10) Avail: NTIS HC A06/MF A01 CSCL 20K

The study focuses on the axisymmetric deformation response of unsymmetrically laminate cylinders loaded in axial compression by known loads. A geometrically nonlinear analysis is used. Though buckling is not studied, the deformations can be considered to be the prebuckling response. Attention is directed at three 16 layer laminates: a (90 sub 8/0 sub 8) sub T; a (0 sub 8/90 sub 8) sub T and a (0/90) sub 4s. The symmetric laminate is used as a basis for comparison, while the two unsymmetric laminates were chosen because they have equal but opposite bending-stretching effects. Particular attention is given to the influence of the thermally-induced preloading deformations that accompany the cool-down of any unsymmetric laminate from the consolidation temperature. Simple support and clamped boundary conditions are considered. It is concluded that: (1) The radial deformations of an unsymmetric laminate are significantly larger than the radial deformations of a symmetric laminate, although for both symmetric and unsymmetric laminates the large deformations are confined

to a boundary layer near the ends of the cylinder; (2) For this nonlinear problem the length of the boundary layer is a function of the applied load; (3) The sign of the radial deformations near the supported end of the cylinder depends strongly on the sense (sign) of the laminate asymmetry; (4) For unsymmetric laminates, ignoring the thermally-induced preloading deformations that accompany cool-down results in load-induced deformations that are under predicted; and (5) The support conditions strongly influence the response but the influence of the sense of asymmetry and the influence of the thermally-induced preloading deformations are independent of the support conditions. Author

N90-25365*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

FREE VIBRATIONS OF THIN-WALLED SEMICIRCULAR GRAPHITE-EPOXY COMPOSITE FRAMES

Huey D. Carden, Ahmed K. Noor, and Jeanne M. Peters (George Washington Univ., Hampton, VA.) May 1990 17 p
(NASA-TM-102680; NAS 1.15:102680) Avail: NTIS HC A03/MF A01 CSCL 20K

A detailed study is made of the effects of variations in lamination and material parameters of thin walled composite frames on their vibrational characteristics. The structures considered are semicircular thin walled frames with I and J sections. The flanges and webs of the frames are modeled by using 2-D shell and plate finite elements. A mixed formulation is used with the fundamental unknowns consisting of both the generalized displacements and stress resultants in the frame. The frequencies and modes predicted by the 2-D finite element model are compared with those obtained from experiments, as well as with the predictions of a non-dimensional thin walled beam finite element model. A detailed study is made of the sensitivity of the vibrational response to variations in the fiber orientation, material properties of the individual layers, and boundary conditions. Author

N90-25366*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

LOADS ANALYSIS AND TESTING OF FLIGHT CONFIGURATION SOLID ROCKET MOTOR OUTER BOOT RING SEGMENTS

Rafiq Ahmed Washington Jun. 1990 47 p
(NASA-TP-3028; NAS 1.60:3028) Avail: NTIS HC A03/MF A01 CSCL 20K

The loads testing on in-house-fabricated flight configuration Solid Rocket Motor (SRM) outer boot ring segments. The tests determined the bending strength and bending stiffness of these beams and showed that they compared well with the hand analysis. The bending stiffness test results compared very well with the finite element data. Author

N90-25367*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THERMOMECHANICAL TESTING TECHNIQUES FOR HIGH-TEMPARATURE COMPOSITES: TMF BEHAVIOR OF SiC(SCS-6)/Ti-15-3

Michael G. Castelli (Sverdrup Technology, Inc., Brook Park, OH.), J. Rodney Ellis, and Paul A. Bartolotta 1990 20 p Presented at the 10th Symposium on Composite Materials: Testing and Design, San Francisco, CA, 24-25 Aug. 1990; sponsored by American Society for Testing and Materials
(NASA-TM-103171; E-5543; NAS 1.15:103171) Avail: NTIS HC A03/MF A01 CSCL 20K

Thermomechanical testing techniques recently developed for monolithic structural alloys were successfully extended to continuous fiber reinforced composite materials in plate form. The success of this adaptation was verified on a model metal matrix composite (MMC) material, namely SiC(SCS-6)/Ti-15V-3Cr-3Al-3Sn. Effects of heating system type and specimen preparation are also addressed. Cyclic lives determined under full thermo-mechanical conditions were shown to be significantly reduced from those obtained under comparable isothermal and in-phase bi-thermal conditions. Fractography and metallography from specimens subjected to isothermal, out-of-phase and in-phase conditions reveal distinct differences in damage-failure modes. Isothermal metallography revealed extensive matrix cracking associated with fiber damage throughout the entire cross-section of the specimen. Out-of-phase metallography revealed extensive matrix damage associated with minimal (if any) fiber cracking. However, the damage was located exclusively at surface and near-surface locations. In-phase conditions produced extensive fiber cracking throughout the entire cross-section, associated with minimal (if any) matrix damage. Author

N90-25368*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

BEHAVIOR OF COMPOSITE/METAL AIRCRAFT STRUCTURAL ELEMENTS AND COMPONENTS UNDER CRASH TYPE LOADS: WHAT ARE THEY TELLING US

Huey D. Carden, Richard L. Boitnott, and Edwin L. Fasanella (Lockheed Engineering and Sciences Co., Hampton, VA.) May 1990 16 p
(NASA-TM-102681; NAS 1.15:102681; USAAVSCOM-TR-90-B-003) Avail: NTIS HC A03/MF A01 CSCL 20K

Failure behavior results are presented from crash dynamics research using concepts of aircraft elements and substructure not necessarily designed or optimized for energy absorption or crash loading considerations. To achieve desired new designs which incorporate improved energy absorption capabilities often requires an understanding of how more conventional designs behave under crash loadings. Experimental and analytical data are presented which indicate some general trends in the failure behavior of a class of composite structures which include individual fuselage frames, skeleton subfloors with stringers and floor beams but without skin covering, and subfloors with skin added to the frame-stringer arrangement. Although the behavior is complex, a strong similarity in the static and dynamic failure behavior among these structures is illustrated through photographs of the experimental results and through analytical data of generic composite structural models. It is believed that the similarity in behavior is giving the designer and dynamists much information about what to expect in the crash behavior of these structures and can guide designs for improving the energy absorption and crash behavior of such structures. Author

N90-25369*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

ROBUST CONTROLLER DESIGNS FOR SECOND-ORDER DYNAMIC SYSTEM: A VIRTUAL PASSIVE APPROACH

Jer-Nan Juang and Minh Phan (National Academy of Sciences - National Research Council, Washington, DC.) May 1990 22 p
(NASA-TM-102666; NAS 1.15:102666) Avail: NTIS HC A03/MF A01 CSCL 20K

A robust controller design is presented for second-order dynamic systems. The controller is model-independent and itself is a virtual second-order dynamic system. Conditions on actuator and sensor placements are identified for controller designs that guarantee overall closed-loop stability. The dynamic controller can be viewed as a virtual passive damping system that serves to stabilize the actual dynamic system. The control gains are interpreted as virtual mass, spring, and dashpot elements that play the same roles as actual physical elements in stability analysis. Position, velocity, and acceleration feedback are considered. Simple examples are provided to illustrate the physical meaning of this controller design. Author

N90-25370*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

OPEN HOLE AND POST-IMPACT COMPRESSION FATIGUE OF STITCHED AND UNSTITCHED CARBON/EPOXY COMPOSITES

M. A. Portanova, C. C. Poe, Jr., and John D. Whitcomb (Texas A&M Univ., College Station.) Jun. 1990 43 p
(NASA-TM-102676; NAS 1.15:102676) Avail: NTIS HC A03/MF A01 CSCL 20K

The performance is studied of a stitched uniweave fabric

composite and that of a toughened tape composite. The effects of stitching on compression fatigue life are addressed. Post impact compression fatigue and open hole fatigue tests were run on an AS4/3501-6 uniweave with stitching and a toughened IM7/8551-7 tape without stitching. Stitching was found to increase the thickness and consequently the weight of the composite material. The two materials were compared on an equal carbon content basis as well as on an equal weight basis. The excess thickness in the stitched uniweave composite was responsible for the lower fatigue life, on an equal carbon basis, compared to the toughened resin tape composite. Comparison of fatigue lives on an equal carbon content basis indicated that puncture or crimp type damage from stitching has very little effect on compression failure. Post impact fatigue test showed that although the damage area in the stitched uniweave composite was twice that of the toughened tape composite, the fatigue lives of the stitched composite were significantly longer than those of the toughened composite. Thus, it appears that the increase in thickness from stitching is much more of a penalty than crimped fibers or puncture type damage from stitching. Author

N90-25371# Ames Lab., IA.
A STUDY ON ULTRASONIC DETECTION AND CHARACTERIZATION OF PARTIALLY CLOSED FATIGUE CRACKS M.S. Thesis - Iowa State Univ.
Lisa Marie VanWyk Feb. 1990 68 p
(Contract W-7405-eng-82)
(DE90-011748; IS-T-1425; IS-T-1393) Avail: NTIS HC A04/MF A01

This study consists of an ultrasonic characterization of two different fatigue cracks in 2024-T351 Aluminum. The first crack was grown with a 5 cycle overload, and the second was grown with a decreasing stress intensity. The first part of the study used through transmitted longitudinal ultrasonic waves to find a distinct change in the transmission coefficient as fatigue cycles were added following the overload and as the crack was statically loaded during the ultrasonic scanning. The second part of the study compared the differences in the through transmitted signals and the shear diffracted signals of the decreasing (Delta)K crack to a crack in the constant (Delta)K condition. In both parts of the study, estimates of the size of the closure region and the magnitude of the residual compressive stress intensity at the crack tip were made through the use of the distributed spring model. This model mathematically characterizes the reaction of an ultrasonic wave to a fatigue crack in a solid. DOE

N90-25372*# Utah Univ., Salt Lake City. Dept. of Materials Science and Engineering.
FRACTOGRAPHY OF COMPOSITE DELAMINATION
W. D. Bascom Jul. 1990 91 p
(Grant NAG1-705)
(NASA-CR-181965; NAS 1.26:181965) Avail: NTIS HC A05/MF A01 CSCL 20K

The microdamage that occurs for Mode 1 and Mode 2 delamination was examined by potting delaminated specimens in a clear epoxy, sectioning through the damage, polishing the cut sections and examining using light microscopy. For Mode 1 delamination of unidirectional carbon fiber reinforced plastic (CFRP) composites, the major observation was fiber bridging including large ligaments of fiber bundles. The Mode 2 delamination of unidirectional laminates revealed a very narrow crack opening with only occasional fiber bridging. Impact testing by repetitive impacts with increasing energy was studied and it was found that this technique does not discern changes in the type of damage with increasing cumulative impact energy. Instead, the changes in the impact response, notably stiffness, are the result of changes in the extent of damage. For laminates with a brittle thermoplastic matrix, 3501-6, there were distinct changes in stiffness that corresponded to the development of through the thickness damage and then to the extension of the damage to the specimen edges. For PEEK and polycarbonate, the changes in stiffness were not as abrupt as for the thermoset. None the less, the damage progressed in the same manner. Author

N90-25373# Aerospace Corp., El Segundo, CA. Materials Sciences Lab.
HIGH-TEMPERATURE CREEP UNDER A NONUNIFORM TEMPERATURE DISTRIBUTION
L. A. Feldman and T. B. Bahder (Harry Diamond Labs., Adelphi, MD.) 15 May 1989 12 p Prepared for ONR, Arlington, VA
(Contract F04701-85-C-0086)
(ATR-88(3728-02)-1) Avail: NTIS HC A03/MF A01

The dimensional stability of a material often plays an important role in the use of that material at high temperature, particularly in structural applications. The determination of creep behavior at high temperature is frequently complicated by a nonuniform temperature distribution. In order to approximate the ideal situation of a uniform temperature distribution, various schemes are used, such as reducing the cross section within the hot zone to restrict the highest stress to a suitably small region. However, in many practical situations, as well as in experiments dealing with the measurement of creep in composites, material is inevitably subjected to a nonuniform temperature distribution. The total creep elongation is then a sum of contributions from material elements with a distribution of temperatures. An example is analyzed of creep in a material under a nonuniform temperature distribution, and simple but realistic assumptions are used for that distribution and for the material creep properties as a function of temperature. Author

N90-25374*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SUMMARY OF A STUDY TO DETERMINE LOW-VELOCITY IMPACT DAMAGE AND RESIDUAL TENSION STRENGTH FOR A THICK GRAPHITE/EPOXY MOTOR CASE
C. C. Poe, Jr. Jun. 1990 36 p
(NASA-TM-102678; NAS 1.15:102678) Avail: NTIS HC A03/MF A01 CSCL 20K

Impacters of various shapes and masses were dropped from various heights onto 36 mm (1.4 in.) thick graphite/epoxy cylinders, which represented filament wound cases (FWC) for the booster motors of the Space Shuttle. Insert solid propellant was cast into some of the cylinders. The cylinders were impacted numerous times around the circumference and then cut into 51 mm (2.0 in.) wide tension specimens, each containing an impact site. Four indenters were used: a sharp corner, two hemispheres, and a bolt-like rod. The diameters of the hemispheres were 12.7 mm mm (0.5 in.) and 25.4 mm (1.0 in.), and the diameter of the rod was 6.3 mm (0.25 in.). Impacts with the rod were simulated by pressing the rod against the face of specimens. For the hemispheres, the damage initiated beneath the surface at a critical contact pressure and was not visible on the surface until an even larger pressure was exceeded. The damage consisted of matrix cracking and broken fiber. The rod an corner made visible surface damage in all tests. For the hemispheres, the tension strength was reduced considerably before the damage was visible on the surface, 30 percent for the 25.4 mm (1.0 in.) diameter hemisphere and 10 percent for the 12.7 mm (0.5 in.) diameter hemisphere. Analytical methods were used to predict the damage and residual tension strength. A factor of safety to account for nonvisible damage was determined. Author

N90-25375*# Sikorsky Aircraft, Stratford, CT.
CALCULATION OF FLIGHT VIBRATION LEVELS OF THE AH-1G HELICOPTER AND CORRELATION WITH EXISTING FLIGHT VIBRATION MEASUREMENTS Final Report
R. Sopher and W. J. Twomey Apr. 1990 186 p
(Contract NAS1-17499)
(NASA-CR-182031; NAS 1.26:182031) Avail: NTIS HC A09/MF A01 CSCL 20K

NASA-Langley is sponsoring a rotorcraft structural dynamics program with the objective to establish in the U.S. a superior capability to utilize finite element analysis models for calculations to support industrial design of helicopter airframe structures. In the initial phase of the program, teams from the major U.S. manufacturers of helicopter airframes will apply extant finite element analysis methods to calculate loads and vibrations of helicopter airframes, and perform correlations between analysis and

measurements. The aforementioned rotorcraft structural dynamics program was given the acronym DAMVIBS (Design Analysis Method for Vibrations). Sikorsky's RDYNE Rotorcraft Dynamics Analysis used for the correlation study, the specifics of the application of RDYNE to the AH-1G, and comparisons of the predictions of the method with flight data for loads and vibrations on the AH-1G are described. RDYNE was able to predict trends of variations of loads and vibrations with airspeed, but in some instances magnitudes differed from measured results by factors of two or three to one. Sensitivities were studied of predictions to rotor inflow modeling, effects of torsional modes, number of blade bending modes, fuselage structural damping, and hub modal content. Author

N90-25376# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Dept. of Product Assurance and Safety.
ESA FRACTURE CONTROL REQUIREMENTS
Mar. 1989 45 p
(ESA-PSS-01-401-Issue-1; ISSN-0379-4059; ETN-90-96984)
Copyright Avail: NTIS HC A03/MF A01

The fracture control requirements imposed on ESA space systems are described. The responsibilities of the different partners within the fracture control program are listed. Potential fracture critical items are identified and evaluated. Analytical life prediction and critical crack size calculation are discussed. Special requirements applicable to pressure vessels, pressure lines, fittings, components and welds are outlined. Nondestructive inspection practices and requirements are described. Other inspection requirements are listed and discussed. ESA

N90-25377# Technical Research Centre of Finland, Espoo. Metals Lab.
THE EFFECT OF LOCAL THINNING ON THE REMAINING LIFE OF SUPERHEATER TUBES
Timo Kujala and Pertti Auerkari Jul. 1989 53 p In FINNISH; ENGLISH summary Sponsored by Federation of Finnish Metal and Engineering Industries Original contains color illustrations
(VTT-RR-631; ISBN-951-38-3507-3; ISSN-0358-5077; ETN-90-96989) Copyright Avail: NTIS HC A04/MF A01

The remaining creep life of a locally thinned superheater tube is evaluated analytically and by Field Emission Microscopy (FEM) analysis. Results of analytical methods and FEM analysis, based on the Norton creep equation, are compared with experimental results. Accelerated creep tests of pressurized superheater tubes are carried out. The life estimates based on analytical and numerical calculations are in satisfactory agreement with experimental results when the measured strains were used to estimate the Norton law parameters. In service conditions the estimated creep life is so long that thinning due to erosion is expected to limit the life of the superheater from where the sample tubes were taken. ESA

N90-25378 Aalborg Portland (Denmark). Cement and Concrete Lab.
FRACTURE MECHANICS IN INTEGRATED DESIGN OF NEW, ULTRA-STRONG MATERIALS AND STRUCTURES
Hans Henrik Bache 1989 19 p Repr. from RILEM Technical Committee 90-FMA Fracture Mechanics to Concrete: Applications (London, England, New York, NY), Chapman and Hall, 1989
(CBL-Reprint-21; ETN-90-96996) Copyright Avail: Aalborg Portland, Roerdalsvej 44, P.O. Box 165, DK-9100 Aalberg, Denmark

The principles of fracture mechanics are used in the development of extremely strong and ductile materials and objects. Emphasis is placed on classifying behavior at all levels according to the degree of brittleness/ductility on the basis of the brittleness number concept. The concept is applied to conventional concrete materials and structures to increase understanding of failure and cracking and to achieve better, more logical and holistic design. The biggest difficulty in the concrete industry is identified as being due to the many separate functions involved. The lack of communication between engineers, contractors and concrete suppliers is identified as slowing progress in concrete technology. ESA

N90-25379# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Structures.
A PHOTOELASTIC ANALYSIS OF THE STRAIN FIELD AROUND IMPACT DAMAGE IN A GRAPHITE FIBRE REINFORCED PANEL SUBJECTED TO COMPRESSION LOADS M.S. Thesis
Johnny Nimvik Mar. 1990 40 p
(Contract FMV-82250-88-033-24-001)
(FFA-TN-1989-48; ETN-90-97040) Avail: NTIS HC A03/MF A01

This experimental investigation compares the strain field around two different impact damage sites in a graphite fiber reinforced panel subjected to compression load and the results obtained using an FE-model where the impact damage is modeled as a whole. The experimental method used is photoelasticity. The out-of-plane deflections, the directions of the principal strains and the reinforcing effect of the photoelastic coating on the panel were investigated. ESA

N90-25380# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Structures.
STRESS INTENSITY FACTORS FOR ARBITRARY TWO-DIMENSIONAL CRACK PROBLEMS INVOLVING CRACK FACE LOADINGS
G. S. Wang and A. F. Blom Feb. 1990 34 p Sponsored by Swedish Board for Technical Development
(FFA-TN-1990-10; ETN-90-97041) Avail: NTIS HC A03/MF A01

A Boundary Element Method (BEM) was developed for a crack under crack face pressure in arbitrary two dimensional problems. The method is based on the basic stress solutions for an infinite plate with a crack loaded by body forces and moment at an arbitrary point, which were derived by Erdogan from the Kolosov-Muskhelishvili fundamental functions, and the basic solution for a crack in an infinite plate under crack surface pressure. Hence, the crack surface needs not to be modeled. Minimal modeling effort is needed to obtain stress intensity factors with the method, and its accuracy is established by comparing computed results to some exact Stress Intensity Factor (SIF) solutions and to other published results for various problems of arbitrary geometries and loadings. ESA

N90-25381# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Structures.
WEIGHT FUNCTIONS AND STRESS INTENSITY FACTORS FOR MODE 1 CRACKS IN ARBITRARY 2D GEOMETRIES UNDER GENERAL CRACK SURFACE LOADING
G. S. Wang and A. F. Blom Mar. 1990 40 p Sponsored by Swedish Board for Technical Development
(FFA-TN-1990-17; ETN-90-97043) Avail: NTIS HC A03/MF A01

Stress intensity factors for mode 1 cracks in arbitrary 2-D geometries under general crack surface loading are derived in closed form by boundary element calculations and approximate weight functions. The boundary element method was developed to deal with arbitrary 2-D crack problems involving uniform crack surface pressure. Reference stress intensity factors calculated by the boundary element method are used to derive stress intensity factors for the same crack under arbitrary crack surface loading with weight functions based on an improved Petroski-Achenbach crack surface displacement approximation. Various crack problems were studied and limitations of the method are discussed. The investigation shows that a self-consistency examination will effectively reveal the accuracy of the derived weight functions and the asssociated stress intensity factors. ESA

N90-25382# Technical Research Centre of Finland, Espoo. Metals Lab.
CALCULATIONS OF WELDING STRESSES AND DEFORMATIONS BY MEANS OF FINITE ELEMENT METHOD

Heikki Keinanen and Tero Oberg Aug. 1989 66 p In FINNISH; ENGLISH summary Sponsored by Technology Development Center, Finland Original contains color illustrations
(VTT-RR-648; ISBN-951-38-3530-8; ISSN-0358-5077; ETN-90-97088) Copyright Avail: NTIS HC A04/MF A01; Government Printing Center, P.O. Box 516, SF-00101 Helsinki, Finland, HC 62 Finnish marks

Methods for the calculation of temperature and stress fields due to welding process are given. Coupling between the temperature and the stress field is considered to be negligible. The analysis of both fields is carried out separately. Both analyses are performed by means of the nonlinear finite element method. The effects of phase transformations are taken into account. The theory is applied for the calculation of temperature and residual stress field in a butt-welded joint. The calculation is made by using the ADINA program. The obtained results are in good agreement with the results given in the literature. ESA

N90-25383# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
ON THE NATURAL FREQUENCIES OF A SHORT CIRCULAR CYLINDER, INCLUDING THE EFFECTS OF ENTRAINED MASS
Ivan S. Gibson Aug. 1989 38 p
(LR-602; ETN-90-97168) Avail: NTIS HC A03/MF A01

Research work undertaken to quantify the effects of entrained mass on the natural frequencies of oscillation of a short-chord circular cylinder is presented. Existing exact methods for the prediction of natural vibrational modes of rings and partial rings in air, and a semi-empirical method which allows for the effect of entrained mass are summarized. A short critique of the latter leads directly to the suggestion of a new and perhaps more accurate method of prediction. The design of an experimental rig in which the circular cylinder may be clamped in several different configurations and subjected to an external periodic force is described. The tests in air and water are examined. Examination of the test results and a detailed appraisal of the accuracy of the suggested calculation method are made. This examination shows that the semi-empirical formulae, incorporating appropriate attenuation factors, may be used to predict the natural vibrational modes with a high degree of accuracy. Suggestions for further experimental research and calculations are included. ESA

N90-25384# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
A SUITABLE TRANSVERSE SHEAR STIFFNESS DEFINITION FOR BUCKLING OF LAMINATES AND SANDWICH PLATES
P. G. vanBladel Jul. 1989 34 p
(LR-603; ETN-90-97169) Avail: NTIS HC A03/MF A01

Two methods to improve the accuracy of the transverse shear stiffness calculation are described. For laminates a more feasible distribution through the thickness shear stress is applied, while for sandwich plates the effect of bending of the faces is taken into account. Both methods yield stiffnesses that can be inserted into the buckling formula for plates with finite transverse shear stiffness under compressive loads. ESA

N90-25385# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
THE STRESS INTENSITY FACTOR AND STRESS CONCENTRATION FOR A FINITE PLATE WITH A SINGLE CRACK EMANATING FROM A HOLE
J. Lai and J. Schijve Sep. 1989 23 p
(LR-607; ETN-90-97172) Avail: NTIS HC A03/MF A01

A full field solution for a finite plate containing a single hole-edge crack is developed by Muskhelishvili's complex variable method. In the derivation of the solution, the equations of equilibrium and compatibility, the traction free condition on crack surfaces, and the single value condition of displacements are satisfied. For a tension loaded rectangular plate with a central hole and a single edge crack, the stress intensity factor of the crack and the peak stress at the opposite hole edge are calculated through the treatment of boundary condition with the minimum potential energy principle. Calculations are made for several geometries and a number of crack lengths. ESA

N90-25386# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
A FINITE WIDTH PLATE WITH A SINGLE CRACK AT THE EDGE OF A CENTRAL HOLE. THE K-VALUE OF THE CRACK AND SIGMA PEAK AT THE OTHER SIDE OF THE HOLE
J. Schijve and J. Lai Sep. 1989 12 p
(LR-608; ETN-90-97173) Avail: NTIS HC A03/MF A01

A comparison was made of the K-solutions for a hole with a single edge crack and a hole with two symmetric edge cracks respectively. K-values for a single edge crack are considerably lower, except for very short cracks. Another comparison is made between K-values for a hole with a single edge crack with K-values for a comparable asymmetric crack without a hole. It shows that the asymmetric crack induces approximately the same stress intensity. It confirms that relatively small craks (lengh l) at holes (diameter d), or other cut outs, can lead to a stress intensity factor, which is approximately equal to K for a much larger crack with an effective length of d+l (tip to tip). A similar conclusion holds for a hole with two opposite edge cracks. If a single edge crack is growing, the stress concentration at the other edge of the hole considerably increases, which may lead to crack initiation, and thus to a hole with to edge cracks. An exercise prediction was not conclusive in indicating that this will be an usual case. However, it might be so depending on material properties, fatigue load and geometry. Hence the continuing damage assumptions made in the military damage tolerance requirements can not be considered to be unreasonable. ESA

N90-25387# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
DERIVATION OF THE GOVERNING EQUATIONS OF ANISOTROPIC CONICAL SHELLS
G. Q. Zhang Mar. 1989 36 p
(LR-609; ETN-90-97174) Avail: NTIS HC A03/MF A01

The governing equations of imperfect, anisotropic conical shells are derived. These are to meet the needs of buckling analysis. Observations made include the possible cause of the nonsimilary of relevant differential operators to be the anisotropic characteristics and geometrical properties. Detailed conclusions are given and existing problems discussed. ESA

N90-25388# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
SOME KINEMATIC RELATIONS OF THIN ELASTIC SHELLS
G. Q. Zhang Mar. 1989 64 p
(LR-612; ETN-90-97175) Avail: NTIS HC A04/MF A01

Both linear shell theories and nonlinear Novozhilov-like theories with the Kirchhoff-Love assumptions are reviewed and discussed in the classical notation. They are used to derive the various kinds of governing equations of shell buckling problems. Detailed conclusions are given. ESA

N90-25389# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
FROM LIE GROUP TRANSFORMATION TO THE GENERALIZED KOITER INITIAL POSTBUCKLING THEORY OF PERFECT SHELLS
G. Q. Zhang Apr. 1989 25 p
(LR-613; ETN-90-97176) Avail: NTIS HC A03/MF A01

The initial postbuckling analysis of shells was addressed. The general methods of Lie group transformation and Koiter initial postbuckling analysis was reviewed and the suggestion that initial postbuckling characteristics can also be given by the coefficients of the infinitesimal generator of the Lie group transformation was studied. The correlations of the two methods were derived. ESA

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N90-25390*# Kansas Univ. Center for Research, Inc., Lawrence. Radar Systems and Remote Sensing Lab.

A LABORATORY INVESTIGATION INTO MICROWAVE BACKSCATTERING FROM SEA ICE Ph.D. Thesis

Jonathan W. Bredow Aug. 1989 188 p Sponsored in part by NASA, Washington, DC

(Contract N00014-89-J-1456)

(NASA-CR-186357; NAS 1.26:186357; RSL-TR-8240-1) Avail: NTIS HC A09/MF A01 CSCL 08L

The sources of scattering of artificial sea ice were determined, backscatter measurements semi-quantitatively were compared with theoretical predictions, and inexpensive polarimetric radars were developed for sea ice backscatter studies. A brief review of the dielectric properties of sea ice and of commonly used surface and volume scattering theories is presented. A description is provided of the backscatter measurements performed and experimental techniques used. The development of inexpensive short-range polarimetric radars is discussed. The steps taken to add polarimetric capability to a simple FM-W radar are considered as are sample polarimetric phase measurements of the radar. Ice surface characterization data and techniques are discussed, including computation of surface rms height and correlation length and air bubble distribution statistics. A method is also presented of estimating the standard deviation of rms height and correlation length for cases of few data points. Comparisons were made of backscatter measurements and theory. It was determined that backscatter from an extremely smooth saline ice surface at C band cannot be attributed only to surface scatter. It was found that snow cover had a significant influence on backscatter from extremely smooth saline ice at C band. Author

N90-25391*# Minnesota Univ., Minneapolis.

ECOLOGICAL STUDY OF PEAT LANDFORMS IN CANADA AND ALASKA

Paul H. Glaser [1989] 77 p Original contains color illustrations

(Contract NAS5-28740)

(NASA-CR-184923; NAS 1.26:184923) Avail: NTIS HC A03/MF A01; 2 functional color pages CSCL 08B

Over 20 percent of the land surface of Canada and Alaska is covered by peatlands, which may be defined as any waterlogged ecosystem with a minimum thickness of 20 cm of organic matter in the soil. Past investigations have demonstrated the value of aerial photographs in identifying the major vegetation types and analyzing the biotic and hydrogeologic processes that control the development of these peatlands. In the present study, LANDSAT TM imagery was used in conjunction with field studies to determine the utility of this satellite sensor for detecting these important processes. Although the vegetation landforms within these major peat basins are visible on aerial photographs, LANDSAT TM imagery provides essential new evidence for their analysis. Spectral data from the LANDSAT TM system provides: (1) synoptic views of the patterns across large portions of these peat basins, indicating important physiographic controls on peatland development, (2) more sensitive detection of the major vegetation types, allowing rapid quantitative estimates to be made of their distribution and aerial extent, (3) discrimination of bog areas with potentially rapid or slow rates of peat accumulation, (4) identification of discharge zones for groundwater, which apparently represents the most important source of alkalinity in these peat basins, and (5) detection of flow patterns in water tracks that appear nearly uniform on standard aerial photographs. Author

N90-25392 New South Wales Univ., Kensington (Australia). School of Surveying.

THE INTEGRATION OF GPS HEIGHTS INTO THE AUSTRALIAN HEIGHT DATUM M.S. Thesis Abstract Only

Robert D. Holloway Sep. 1988 3 p

Avail: Issuing Activity

The Global Positioning System (GPS) is being used to determine ellipsoidal height differences (delta h) over baselines by organizations who are attracted to its efficiencies in use and accuracy of results compared to conventional surveying techniques. For these heights to be physically meaningful they must be integrated into the Australian Height Datum (AHD) to be compatible with other spirit levelled heights (delta H). The GPS heights are referred to the reference ellipsoid of the satellite system whilst the reference surface of the AHD is observed mean sea level at 30 tide gauges around the Australian coastline being a close approximation of the geoid. The difference between the two surfaces at a point is the geoid-ellipsoid separation (N), or more commonly and more accurately, the difference in the geoid-ellipsoid separation (delta N) when expressed over a baseline. The three components of the equation used to transform GPS heights into the AHD, are investigated. Author

N90-25393# Beleidscommissie Remote Sensing, Delft (Netherlands).

CAESAR: PERFORMANCE AND FIRST EVALUATION OF APPLICATION POSSIBILITIES Final Report

M. Donze, R. J. Bijlsma, H. Buiteveld, J. G. P. W. Clevers, H. W. J. vanKasteren, C. Meulstee, A. H. J. M. Pellemans, W. J. Looyen, ed., and R. W. vanSwol, ed. (National Aerospace Lab., Emmeloord, Netherlands) Jun. 1989 103 p

(BCRS-89-06; ETN-90-96758) Avail: NTIS HC A06/MF A01

The performance and first evaluation of application possibilities of the Dutch CCD Airbone Experimental Scanner for Applications in Remote sensing (CASEAR), a multispectral push-broom scanner designed for land and sea (water) observation, in up to nine spectral bands, is described. CAESAR was developed and the following objectives were fulfilled: technical knowledge about CCD detectors and practical experience with their application in remote sensing were gained and an important research tool was made available to remote sensing scientists. The scanner and preprocessing algorithms were completed in 1988. In the preprocessing stage, both radiometric and geometric corrections are applied. The results of the experiments, realized in Aug. 1986 and organized testfields on land and water are discussed. ESA

N90-25394# Beleidscommissie Remote Sensing, Delft (Netherlands).

MAPPING AND MONITORING LAND USE AND LAND DEGRADATION IN PART OF EAST KALIMANTAN, INDONESIA, USING AEROSPACE REMOTE SENSING TECHNIQUES: A SPOT CASE STUDY Final Report

F. W. Hilwig, M. Sukardi, and S. Eko (Bappeda, East Kalimanta, Indonesia) Jun. 1989 58 p

(BCRS-88-16B; ETN-90-96763) Avail: NTIS HC A04/MF A01

An approach elaborated to monitor land use and land degradation in transmigration areas is presented. A region around Samarinda, East Kalimantan, is analyzed using LANDSAT and SPOT satellite data. Both visual and a computer-assisted analysis were attempted to classify landcover and obtain a measure of erosion hazards in some sample areas, leading to land degradation. SPOT imagery in the form of color composites, in a scale of 1:50,000, provided superior tools to traditional false color composites in the field to survey and map various land use classes under tropical rainforest conditions. Computer-assisted classification of land cover classes is applied. The process of

land degradation was inferred. The time available did not allow to separate the determination of the factors affecting the erodability of soils in managed forest such fire, grazing, logging and road building. ESA

N90-25395# Instituut voor Culturrtechniek en Waterhuishouding, Wageningen (Netherlands).
MARS (MONITORING AGRO-ECOLOGICAL RESOURCES WITH REMOTE SENSING AND SIMULATION) DEFINITION STUDY: RESULTS OF THE PREPARATORY PHASE Main Report
J. J. A. Berkhout, J. Huijgen (Center for World Food Studies, Wageningen, Netherlands), S. Azzali, and M. Menenti 1988 3 p Sponsored by Beleidscomissie Remote Sensing Original contains color illustrations
(Rept-17; BCRS-88-06; ISSN-0921-0881; ETN-90-96775) Avail: NTIS HC A07/MF A01; Institute for Land and Water Management Research, P.O. Box 35, 6700 AA Wageningen, Netherlands, 35 Dutch guilders

Results of the MARS (monitoring agro-ecological resources with remote sensing and simulation) definition study with regard to a possible application in Zambia are presented. Crop growth simulation model, assessment of the start of the growing season, ARTEMIS rainfall estimation, digital crop and land use identification by LANDSAT-TM images, and digital matching of maps with satellite images are covered. The proposed MARS system is concluded to be feasible in Zambia, although further calibration and validation activities are required. ESA

N90-25396*# Arizona Univ., Tucson. Remote Sensing Center.
MULTISENSOR MONITORING OF DEFORESTATION IN THE GUINEA HIGHLANDS OF WEST AFRICA Final Report
Peter T. Gilruth and Charles F. Hutchinson 23 Apr. 1990 46 p (Grant NAGw-1359)
(NASA-CR-186709; NAS 1.26:186709) Avail: NTIS HC A03/MF A01 CSCL 02F

Multiple remote sensing systems were used to assess deforestation in the Guinea Highlands (Fouta Djallon) of West Africa. Sensor systems included: (1) historical (1953) and current (1989) aerial mapping photography; (2) current large-scale, small format (35mm) aerial photography; (3) current aerial video imagery; and (4) historical (1973) and recent (1985) LANDSAT MSS. Photographic and video data were manually interpreted and incorporated in a vector-based geographic information system (GIS). LANDSAT data were digitally classified. General results showed an increase in permanent and shifting agriculture over the past 35 years. This finding is consistent with hypothesized strategies to increase agricultural production through a shortening of the fallow period in areas of shifting cultivation. However, results also show that the total area of both permanent and shifting agriculture had expanded at the expense of natural vegetation and an increase in erosion. Although sequential LANDSAT MSS cannot be used in this region to accurately map land over, the location, direction and magnitude of changes can be detected in relative terms. Historical and current aerial photography can be used to map agricultural land use changes with some accuracy. Video imagery is useful as ancillary data for mapping vegetation. The most prudent approach to mapping deforestation would incorporate a multistage approach based on these sensors. Author

N90-25397*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SEASONAL LAI IN SLASH PINE ESTIMATED WITH LANDSAT TM
Paul J. Curran, Jennifer L. Dungan, and Henry L. Gholz (Florida Univ., Gainesville.) May 1990 20 p Original contains color illustrations
(NASA-TM-102278; A-90060; NAS 1.15:102278) Avail: NTIS HC A03/MF A01; 2 functional color pages CSCL 02F

The leaf area index (LAI, total area of leaves per unit area of ground) of most forest canopies varies throughout the year, yet for logistical reasons it is difficult to estimate anything more detailed than a seasonal maximum LAI. To determine if remotely sensed data can be used to estimate LAI seasonally, field measurements of LAI were compared to normalized difference vegetation index (NDVI) values derived using LANDSAT Thematic Mapper (TM) data, for 16 fertilized and control slash pine plots on 3 dates. Linear relationships existed between NDVI and LAI with R(sup 2) values of 0.35, 0.75, and 0.86 for February 1988, September 1988, and March, 1989, respectively. This is the first reported study in which NDVI is related to forest LAI recorded during the month of sensor overpass. Predictive relationships based on data from eight of the plots were used to estimate the LAI of the other eight plots with a root-mean-square error of 0.74 LAI, which is 15.6 percent of the mean LAI. This demonstrates the potential use of LANDSAT TM data for studying seasonal dynamics in forest canopies. Author

N90-25398# European Space Agency, Paris (France).
REMOTE SENSING AND THE EARTH'S ENVIRONMENT
W. R. Burke, comp. Mar. 1990 154 p Conference held in Alpbach, Austria, 26 Jul. - 4 Aug. 1989; sponsored by ESA, CNES, DLR, and SANW
(ESA-SP-301; ISBN-92-9092-046-7; ISSN-0379-6566; ETN-90-96978) Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

Various aspects of remote sensing as concerns monitoring of the Earth's environment are discussed. Cloud analysis using satellite data, cloud dynamics and microphysics analyzed by radar, Earth radiation budget, and airborne chemistry measurements are described. Ways of interpreting ocean color and snow and land ice are discussed. Snow cover mapping and computer simulations of snowmelt runoff are discussed. Forest land monitoring, geological aspects of remote sensing and global changes in tropospheric chemistry are investigated. For individual titles, see N90-25399 through N90-25416.

N90-25399# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).
REMOTE SENSING FOR BETTER UNDERSTANDING OF THE SYSTEM EARTH
H. Haeberle *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 3-6 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

The need to better understand the systems controlling the Earth's atmosphere is stressed. The research priorities guiding the World Climate Research Program, the Global Change Research Program and the International Geosphere-Biosphere Program are defined. Modeling, measurement and prediction techniques are described. The Earth's hydrologic and carbon cycles are discussed. The need for an Earth Observing System to which all national and international programs contribute is stressed. The recommended payload for such an Earth Observing System is presented. ESA

N90-25400# Centre National d'Etudes Spatiales, Paris (France). Direction des Programmes.
CNES SPACE PROGRAMMES RELATED TO CLIMATE c47
A. Ratier *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 7-16 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

The guidelines of the national and cooperative environmental programs conducted by CNES are summarized. Synergy between scientific and application projects and the promotion of innovative concepts likely to meet the requirements of the World Climate Research and International Geosphere-Biosphere programs is demonstrated. The TOPEX-POSEIDON and BEST missions are described. The implementation and definition phases of these missions are parallel to those of the WOCE (World Ocean Circulation Experiment) and GEWEX (Global Ocean Energy and

Water Budget Experiment) experiments. Like the SPOT series, they are expected to provide imagery of land surfaces until the year 2000. ESA

N90-25401# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Atmospheric Physics.
CLOUD ANALYSIS WITH SATELLITE DATA Abstract Only **c47**
K. T. Kriebel *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 17 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

Cloud detection, classification and analysis are discussed. The algorithm package APOLLO (AVHRR processing scheme over clouds) is used in the analysis. Cloud detection, using this algorithm, decides whether a pixel is cloud free, fully cloudy, or neither of the two, i.e., partly cloudy. Cloud classification mainly establishes cloud coverages for different types of clouds. Cloud optical properties such as optical depth and liquid water path from fully cloudy pixels is described. An overview of the different techniques used in cloud analysis is presented. ESA

N90-25402# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Atmospheric Physics.
CLOUD DYNAMICS AND CLOUD MICROPHYSICS BY RADAR MEASUREMENTS **c47**
Peter Meischner *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 19-26 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

Advanced radar techniques for meteorological research are discussed. Wave propagation studies in the atmosphere are described. Doppler measurement of polarimetric measurements, and data processing and interpretation are covered. The polarimetric C-band Doppler radar is described. Polarimetric and Doppler measurements performed nearly simultaneously with this system result in detailed insights into the coupled dynamical and microphysical processes of precipitation formation. ESA

N90-25403# Laboratoire de Meteorologie Dynamique du CNRS, Palaiseau (France).
EARTH RADIATION BUDGET AND CLIMATE **c47**
Robert Kandel *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 27-33 (For primary document see N90-25398 19-43)
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The role of radiative processes in climate and climate change is discussed. The relation between the Earth radiation budget and climate in the conceptual framework of relatively simple models is considered. The critical role of clouds and the uncertainties related to radiative forcing and feedback are discussed. One dimensional climate models are considered in terms of Earth radiation budget studies. Global mean radiative-convective models are taken into consideration. Regional climate and Earth radiation budgets are discussed. ESA

N90-25404# Laboratoire de Meteorologie Dynamique du CNRS, Palaiseau (France).
EARTH RADIATION BUDGET MEASUREMENTS FROM SPACE **c46**
Robert Kandel *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 35-42 (For primary document see N90-25398 19-43)
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Ways in which data processing must take into account the sampling characteristics of the satellite-orbit/instrument combination are discussed. Incorporation into these studies of the anisotropy and diurnal variation of the radiation reflected and emitted by the Earth/atmosphere system is considered. The role of the ongoing Earth Radiation Budget Experiment (ERBE) in resolving some of these questions is discussed. The usefulness of integrating basic observations made by several polar orbiting platforms so as to obtain complete diurnal coverage is considered. ESA

N90-25405# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Atmospheric Physics.
AIRBORNE CHEMISTRY MEASUREMENTS **c45**
Dieter Paffrath *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 43-49 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

The problems and technical opportunities involved in the measurement of air chemistry parameters in the atmosphere are discussed. These parameters include the concentration of trace substances (gases and aerosols) injected into the atmosphere by natural and anthropogenic effects as well as meteorological parameters influencing the space and time distribution of trace substances. It is shown that atmospheric chemistry research can be performed from aircraft and spaceborne platforms. Examples and results of measurements are demonstrated. ESA

N90-25406# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Optoelectronics.
OCEAN COLOUR: METHODS, TECHNOLOGIES, APPLICATIONS **c48**
Hans vanderPiepen *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 51-59 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

Remote sensing of water color/chlorophyll fluorescence and its application to the mapping of pigments, suspended matter and other substances from airborne and spaceborne sensors is discussed. The physical processes involved are described. Methods used for quantitative interpretation of data are discussed. Applications of the technique in monitoring algae blooms and other dynamic processes are demonstrated. Multispectral scanner technologies and imaging spectrometers are discussed with special reference to ESA's Earth Observation Program. ESA

N90-25407# Innsbruck Univ. (Austria). Inst. of Meteorology and Geophysics.
SNOW AND LAND ICE IN THE CLIMATE SYSTEM: RESEARCH PROBLEMS AND POSSIBILITIES OF REMOTE SENSING
Helmuth Rott *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 61-75 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

The significance of the main components of the cryosphere, ice sheets, seasonal snow cover and glaciers, is discussed. Interpretation of climatic data from the past as a means of improving climate modeling techniques is called for. The physical basis for remote sensing of snow and ice is reviewed. Possibilities for present and future satellite sensors are discussed. Examples of snow and ice studies based on satellite data in the optical and microwave areas of the spectrum are discussed. ESA

N90-25408# Bern Univ. (Switzerland). Dept. of Geography.
SNOW COVER MAPPING AND SNOWMELT RUNOFF SIMULATIONS ON MICROCOMPUTERS
Michael F. Baumgartner *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 77-85 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

The importance of remotely sensed snow cover data in developing a deterministic Snowmelt Runoff Model (SMR) is discussed. Methods and problems involved in periodic snow cover mapping are presented. Snowmelt runoff simulation with the SRM is represented for two meteorologically different years. The differences occurring in the simulated runoff due to snow cover imputs based on different remote sensing systems are discussed. Hardware and software aspects for operational snow cover mapping and runoff simulation/forecasting are discussed. ESA

N90-25409# Freiburg Univ. (Germany, F.R.). Abt. fuer Luftbildmessung und Fernerkundung.
INVENTORY AND MONITORING OF EXTENDED FOREST LANDS BY REMOTE SENSING
G. Hildebrandt *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 87-94 (For primary document see N90-25398 19-43)
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Methodological aspects of inventory and monitoring of extended forest lands are discussed. Problems which arise from the variability and similarities of spectral signatures are reviewed. Ways of overcoming such problems by suitable choice of the sensor and recording date are presented. The need to harmonize these two factors with the phenology of the vegetation types including consideration of multitemporal data recording is stressed. Results from practical and experimental inventory and monitoring of forests lands are presented. ESA

N90-25410# Joanneum Research Centre, Graz (Austria). Inst. for Digital Image Processing and Computer Graphics.
GEOCODED SPACEBORNE SAR PRODUCTS FOR GEOLOGICAL APPLICATIONS **c46**
Manfred F. Buchroithner *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 95-103 (For primary document see N90-25398 19-43)
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The potential of spaceborne SAR (Synthetic Aperture Radar) imagery for geological applications is presented. Background information on SAR image generation is given, stressing the use of a geocoding procedure. Geocoding is a prerequisite for combination with other (remote sensing) data sets. Advantages and drawbacks of geometrically rectified versus uncorrected imagery are treated. One of the advantages of SAR imagery is the accentuation of geomorphological features in low to medium relief terrain. ESA

N90-25411# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.). Div. of Atmospheric Chemistry.
GLOBAL CHANGES IN TROPOSPHERIC CHEMISTRY **c46**
Paul J. Crutzen *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 105-113 (For primary document see N90-25398 19-43)
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Changes in the chemistry of the atmosphere due to human intervention are described. The importance of the concentration of gases in the troposphere in maintaining the composition of the atmosphere is discussed. Due to a variety of human activities, especially through increasing emissions of CH4, CO and NOX, the concentration of tropospheric ozone and hydroxyl are increasing in the polluted and decreasing in the clean tropospheric environments. A gradual buildup of trace gases removed by reactions involving OH radicals is predicted. ESA

N90-25412# Technische Univ., Graz (Austria). Inst. of Theoretical Geodesy.
SOLID EARTH, GRAVITY FIELD AND ENVIRONMENT **c46**
Hans Suenkel *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 115-123 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

The use of geodetic spaceborne position and gravity field sensors in monitoring environmental changes is discussed. Large scale motion and deformation of tectonic plates, small scale deformation of surface structures, changes in day length and in the direction or the Earth's axis of rotation are some applications of spaceborne position and gravity field sensors in Earth observation. The need to bridge the gap between the remote sensing community and geodetic technology is stressed. The structure of the Earth's gravity field, changes in mean sea level and dynamic sea surface topography are several other examples of features which can be elucidated by geodetic techniques. ESA

N90-25413# Food and Agriculture Organization of the United Nations, Rome (Italy). Environmental Monitoring Group.
OPERATIONAL SATELLITE ENVIRONMENTAL MONITORING FOR FOOD SECURITY BY FAO: THE ARTEMIS SYSTEM
Jelle U. Hielkema *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 125-134 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

The use of data from environmental and Earth resources satellites in improving the information bases of FAO (Food and Agriculture Organization) Global Information and Early Warning System (GIEWS) is described. The ARTEMIS satellite environmental monitoring system for real and near realtime precipitation and vegetation assessment in Africa, the Near East and Southwest Asia is described. It is based on the integrated use of high frequency Meteosat and NOAA AVHRR data. The developmental status of the DIANA satellite designed to permit realtime transmission of high volume ARTEMIS data to user terminals at regional and national levels in Africa is described. ESA

N90-25414# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Optoelectronics.
VEGETATION STRESS MONITORING BY FLUORESCENCE
Kurt P. Guenther *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 135-142 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

Three different methods for the detection of plant stress are presented. They are designed to help improve the performance of laser-fluoro-sensors carried in aircraft used for assessing plant identification and plant stress by spectral analysis. Time resolved measurements of the induction kinetics of predarkened plants is one method used. Spectral resolved measurements of the fluorescence emission bands is a second method. Measurements of the lifetime of the fluorescence in the ps and ns domain is the third method. The physical and biological background of these laboratory techniques and their transformation for future remote sensing applications are discussed. ESA

N90-25415# Karlsruhe Univ. (Germany, F.R.). Inst. of Photogrammetry and Remote Sensing.
LAND APPLICATION OF IMAGING SPECTROMETRY
Hermann Kaufmann and J. Bodechtel (Joint Research Centre of the European Communities, Ispra, Italy) *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 143-150 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

The theoretical background, instrumentation and data processing procedures involved in imaging spectrometry are summarized. Possibilities for data evaluation for geological and vegetative targets are discussed. Applications in several different examples are presented. The feasibility of building and operating imaging spectrometer devices with 10 nm sampling devices and

sufficient S/N ratios, GIVOF and swaths is predicted to open a whole new dimension in user applications. Development of fast and reliable software for calibration and automated data processing to handle the large amount of data is a prerequisite to such development. ESA

N90-25416# European Space Agency. ESRIN, Frascati (Italy). Earthnet Programme Office.
FUTURE DEVELOPMENTS OF REMOTE SENSING SYSTEMS: DATA MANAGEMENT AND PROCESSING
Luigi Fusco *In its* Remote Sensing and the Earth's Environment Mar. 1990 p 151-158 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

The status of remote sensing data management, with particular emphasis on the ESA Earthnet program is presented. Plans for handling the data from ERS-1 are outlined. The planned international contribution to the Space Station Polar Platforms systems is described. Details of the NASA and ESA plans for polar platforms data management and the international coordination of efforts are presented. Comparison of data handling aspects are made to illustrate the increased complexity of the systems. ESA

N90-25417# European Space Agency, Paris (France).
REFLECTION INDICATRICES OF NATURAL SURFACES FOR AVHRR CHANNELS 1 AND 2
Reinhold Busen (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) May 1990 130 p Transl. into ENGLISH from Reflexions Indikatrizen Natuerlicher Oberflaechen fuer die AVHRR-Kanaele 1 und 2 (Oberpfaffenhofen, Fed. Republic of Germany, DFVLR), 1989 116 p Original language document was announced as N90-13882
(ESA-TT-1192; DFVLR-Mitt-89-16; ETN-90-97086) Avail: NTIS HC A07/MF A01

Reflection indicatrices for different types of surfaces and vegetative cover are presented. These indicatrices directly describe the relative angular distribution of the reflected radiation as a function of the solar and observer zenith angles and of relative azimuth angle of the direction of observation. The given indicatrices are valid in the spectral regions of the AVHRR (Advanced Very High Resolution Radiometer) channels 1 and 2, i.e., between 0.58 and 0.68 microns, and between 0.725 and 1.1 microns, respectively. The results are available as data sets, and the possibilities of access are described. ESA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N90-25418*# Colby Coll., Waterville, ME. Dept. of Physics and Astronomy.
LEO HIGH VOLTAGE SOLAR ARRAY ARCING RESPONSE MODEL, CONTINUATION 5 Interim Report
Roger N. Metz Apr. 1989 89 p
(Grant NAG3-576)
(NASA-CR-186505; NAS 1.26:186505) Avail: NTIS HC A05/MF A01 CSCL 10A

The modeling of the Debye Approximation electron sheaths in the edge and strip geometries was completed. Electrostatic potentials in these sheaths were compared to NASCAP/LEO solutions for similar geometries. Velocity fields, charge densities and particle fluxes to the biased surfaces were calculated for all cases. The major conclusion to be drawn from the comparisons of our Debye Approximation calculations with NASCAP-LEO output is that, where comparable biased structures can be defined and sufficient resolution obtained, these results are in general agreement. Numerical models for the Child-Langmuir, high-voltage electron sheaths in the edge and strip geometries were constructed. Electrostatic potentials were calculated for several cases in each of both geometries. Velocity fields and particle fluxes were calculated. The self-consistent solution process was carried through one cycle and output electrostatic potentials compared to NASCAP-type input potentials. Author

N90-25419*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ENERGY STORAGE FOR A LUNAR BASE BY THE REVERSIBLE CHEMICAL REACTION: CaO+H2O REVERSIBLE REACTION Ca(OH)2
Marla E. Perez-Davis and Frank DiFilipo (Case Western Reserve Univ., Cleveland, OH.) Jun. 1990 7 p
(NASA-TM-103145; E-5497; NAS 1.15:103145) Avail: NTIS HC A02/MF A01 CSCL 10C

A thermochemical solar energy storage concept involving the reversible reaction CaO + H2O yields Ca(OH)2 is proposed as a power system element for a lunar base. The operation and components of such a system are described. The CaO/H2O system is capable of generating electric power during both the day and night. The specific energy (energy to mass ratio) of the system was estimated to be 155 W-hr/kg. Mass of the required amount of CaO is neglected since it is obtained from lunar soil. Potential technical problems, such as reactor design and lunar soil processing, are reviewed. Author

N90-25420*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN ANALYSIS OF THE CONTACT SINTERING PROCESS IN III-V SOLAR CELLS
Victor G. Weizer and Navid S. Fatemi (Sverdrup Technology, Inc., Brook Park, OH.) 1990 8 p Presented at the 21st Photovoltaics Specialists Conference, Kissimmee, FL, 21-25 May 1990; sponsored by IEEE
(Contract NAS3-25266)
(NASA-TM-103179; E-5556; NAS 1.15:103179) Avail: NTIS HC A02/MF A01 CSCL 10A

The possibility of eliminating the gross mechanical changes that take place during sintering while retaining the processes that reduce contact resistivity is investigated. Before considering the electrical aspects, however, it is necessary to understand the relevant metallurgy. As the sintering process proceeds in the InP-Au system, dramatic color changes occur that enable a precise measurement of the kinetics of each step. A detailed insight into the processes that control each stage in the InP-Au interaction has resulted. It is shown that contact sintering in the InP-Au system consists of three consecutive stages, each of which is controlled by a separate mechanism. Author

N90-25421# David Taylor Research Center, Bethesda, MD. Dept. of Propulsion and Auxiliary Systems
ON THE RELATIONSHIP BETWEEN ENERGY DENSITY AND NET POWER (INTENSITY) IN COUPLED ONE-DIMENSIONAL DYNAMIC SYSTEMS Final Report
G. Maidanik and J. Dickey May 1990 13 p
(AD-A221071; DTRC/PAS-90/22) Avail: NTIS HC A03/MF A01 CSCL 10/1

A formalism for the power flow vector of a complex composed of a multitude of one-dimensional dynamic systems has been developed using wave propagation concepts. In this formalism, the complex is defined in terms of two diagonal propagator matrices, two terminal position vectors, and two junction matrices. An element in a propagator matrix describes the manner in which power, in a specific dynamic system, propagates toward a junction. An element in a terminal vector defines the terminal position, in a specific dynamic system, at a junction. A junction is the boundary that defines the coupling among the dynamic systems at a common terminal vector. An element in a junction matrix defines either the coupling (transmission action) between two distinct dynamic

systems or the self-coupling (reflection action) at the designated junction. The formalism accounts for the energetics of coupled one-dimensional dynamic systems. Neglecting cross terms between linear propagation toward one and the other junction, that the stored energy density vector is the sum of the stored energy density vector associated with propagation of power toward one junction and with that propagating toward the other junction. Under the same conditions, the net power (intensity) vector is the difference between the power vector associated with power propagation toward one junction and with that propagating toward the other. Since the energy stored and the power flow are simply related by a speed of propagation, it is argued that the stored energy density vector and the net power (intensity) vector are supplemental quantities. GRA

N90-25422# Midwest Research Inst., Golden, CO.
PHOTOVOLTAIC ENERGY PROGRAM SUMMARY. VOLUME 2: RESEARCH SUMMARIES
Jan. 1990 151 p
(Contract DE-AC02-83CH-10093)
(DE89-009474; DOE/CH-10093/59-Vol-2) Avail: NTIS HC A07/MF A01

The Federal government has conducted the National Photovoltaics Program since 1975. Its purpose is to provide focus, direction, and funding for the development of terrestrial photovoltaic technology as an energy option for the United States. Since the inception of the program, progress has been impressive; conversion efficiencies have increased from 14 percent to 25 percent in laboratory produced cells made of crystalline silicon. Efficiencies in cells using advanced thin-film materials have progressed from 2 percent up to 14 percent in the laboratory. In addition, module lifetime has increased fivefold, while production costs have decreased tenfold. This summary is prepared each year to provide an overview of the government-funded activities within the National Photovoltaics Program. Tasks conducted in house by the participating national laboratories or under contract by industrial, academic, and other research institutions are highlighted. This document covers those activities initiated, renewed, or completed during fiscal year 1989 (October 1, 1988 through September 30, 1989). DOE

N90-25423# Midwest Research Inst., Golden, CO.
WIND ENERGY PROGRAM SUMMARY. VOLUME 2: RESEARCH SUMMARIES
Jan. 1990 51 p
(Contract DE-AC02-83CH-10093)
(DE89-009480; DOE/CH-10093/65-Vol-2) Avail: NTIS HC A04/MF A01

The Federal Wind Energy Program performs applied research in the sciences of wind turbine dynamics and the development of advanced components and systems. These efforts have resulted in major advancements toward the development and commercialization of wind technology as an alternative energy source. At the end of 1989, 14,600 wind turbines have demonstrated that commercial use of wind energy technology can be a viable source of electric power. This publication is one of a series of documents on the Renewable Energy programs sponsored by the U.S. Department of Energy. An overview of all the programs is available, entitled Programs in Renewable Energy. DOE

N90-25424# Midwest Research Inst., Golden, CO.
STRUCTURAL AND ELECTRONIC STUDIES OF a:SiGe:H ALLOYS Annual Report, 1 Sep. 1988 - 30 Jun. 1989
W. Paul (Harvard Univ., Cambridge, MA.) Feb. 1990 159 p
(Contract DE-AC02-83CH-10093)
(DE90-000313; SERI/TP-211-3655) Avail: NTIS HC A08/MF A01

This report describes a research program to investigate hydrogenated amorphous silicon-germanium alloys (a-Sil-xGex:H) for solar-cell applications. Specifically, studies were carried out to determine why these low-band-gap alloys exhibit photo-electronic properties inferior to those of hydrogenated amorphous silicon (a-Si:H). Two contributors to this phenomenon were established: (1) An amorphous semiconductor of smaller band gap than a-Si:H, but possessing tails to the conduction band and valence band densities of states of the same extent as in a-Si:H, and also possessing at least the same density of defect-related states, was bound to have shorter electron and hole lifetimes. (2) The structure of alloy films (whether with smaller or larger band gaps than that of a a-Si:H), exhibited considerable inhomogeneity; this led to an even greater reduction in the quantum-efficiency mobility lifetime product. The extensive studies confirmed that a-Ge:H is much poorer than a-Si:H from a photoelectronic standpoint. DOE

N90-25425# Sandia National Labs., Albuquerque, NM.
THE PHOTOVOLTAIC CONCENTRATOR INITIATIVE
J. L. Chamberlin and D. L. King 1989 6 p Presented at the 21st IEEE Photovoltaic Specialists Conference, Kissimmee, FL, 21-25 May 1990
(Contract DE-AC04-76DP-00789)
(DE90-011228; SAND-89-2501C; CONF-900542-7) Avail: NTIS HC A02/MF A01

Recognizing the recent improvements in concentrator cell efficiencies and progress in low-cost module designs, the U.S. Department of Energy has authorized Sandia National Laboratories to implement and administer the Photovoltaic Concentrator Initiative, a program to accelerate the advent of a self-sustaining industry capable of providing cost-effective photovoltaic concentrating-collector power systems. Toward this goal, competitively placed, multiyear developmental efforts will be established with companies committed to the commercialization of the resulting technologies in the Initiative's two major areas: concentrator-cell and concentrating-collector development. Since Sandia has unique capabilities in both of these areas, cooperative developmental efforts are planned. The features of the Initiative and the progress to date toward satisfying its purpose are given. DOE

N90-25426# Sandia National Labs., Albuquerque, NM.
THE EFFECTS OF DIFFERENT DIFFUSION SOURCES ON SILICON SOLAR CELL RECOMBINATION PROPERTIES
Douglas S. Ruby and John D. McBrayer 1990 12 p Presented at the 21st IEEE Photovoltaic Specialists Conference, Kissimmee, FL, 21-25 May 1990
(Contract DE-AC04-76DP-00789)
(DE90-011235; SAND-89-2488C; CONF-900542-8) Avail: NTIS HC A03/MF A01

The importance of forming low-recombination passivated emitter regions while maintaining high bulk recombination lifetimes has been clearly established as necessary for the fabrication of high-efficiency silicon solar cells. Many different types of diffusion sources are available for performing the emitter diffusions for each dopant species. Each could affect device quality in a unique way, and each has particular attributes that determine its cost effectiveness. The effects of PH3 and POCl3 diffusion sources are compared on recombination lifetimes and emitter saturation currents. The relative costs associated with each, including material, capital and safety costs are also examined. It was found that while both sources can produce a higher yield in this regard. Because the safety concerns regarding PH3 can be addressed in a cost-effective manner, it has a cost advantage over POCl3 when used for mass production. DOE

N90-25427# Sandia National Labs., Albuquerque, NM. Photovoltaic Cell Research Div.
CRYSTALLINE PHOTOVOLTAIC CELL RESEARCH, STATUS, AND FUTURE DIRECTION
D. E. Hasti, D. L. King, and John D. McBrayer 1990 10 p Presented at the 21st IEEE Photovoltaic Specialists Conference, Kissimmee, FL, 21-25 May 1990
(Contract DE-AC04-76DP-00789)
(DE90-011478; SAND-89-2516C; CONF-900542-5) Avail: NTIS HC A02/MF A01

Sandia National Laboratories has overall DOE PV Program responsibility for research and development of one-sun crystalline silicon and concentrator cell technology for both crystalline silicon

and III-V materials. The goal of this research is to establish the technology base from which U.S. industry can choose options for commercialization. This research is accomplished through a combination of university, industry, and national laboratory efforts. The Photovoltaic Device Fabrication Laboratory (PDFL) and the Photovoltaic Device Measurements Laboratory (PDML) are both operated as part of this effort. The PDFL provides continuity for cell processing research and an essential technology transfer link between universities and industry. Cell measurements and performance analysis are conducted in the PDML. Cell modeling and studies of basic cell physics are also important aspects of this research. The status of crystalline cell research is reviewed, recent results are presented, and future research directions are outlined. Future directions include an initiative to develop reliable, high-efficiency, cost effective concentrator cells in U.S. industry. Collaborative research into production engineering will be an important aspect of this concentrator initiative. Production oriented research in cooperation with the U.S. one-sun crystalline silicon industry will also be the future direction of the one-sun crystalline cell project. DOE

N90-25428# Midwest Research Inst., Golden, CO.
SERI SOLAR RADIATION RESOURCE ASSESSMENT PROJECT Annual Progress Report, FY 1989
Carol J. Riordan, Roland L. Hulstrom, E. Maxwell, T. L. Stoffel, M. Rymes, D. Myers, and S. Wilcox May 1990 56 p
(Contract DE-AC02-83CH-10093)
(DE90-000307; SERI/PR-215-3617) Avail: NTIS HC A04/MF A01

The U.S. Department of Energy's (DOE) Resource Assessment Program develops a scientific understanding of and information about the availability and characteristics of renewable energy resources, such as solar energy, used by renewable energy technologies. The program is currently focused on solar radiation resource assessment for the United States. DOE's lead center for solar radiation resource assessment is the Solar Radiation Research and Metrology Branch (SRRMB)* in the Solar Electric Research Division at the Solar Energy Research Institute (SERI). Work is performed at SERI under the Solar Radiation Resource Assessment Project (SRRAP) in the SRRMB. This annual report summarizes the activities and accomplishments of the SRRAP at SERI for the period 1 October 1988 through 30 September 1989, fiscal year (FY) 1989. DOE

N90-25429# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
RESEARCH ON DESIGN AND FABRICATION OF HIGH-EFFICIENCY SOLAR CELLS
A. Rohatgi, S. R. Ringel, and A. W. Smith Jun. 1990 120 p Submitted for publication
(Contracts DE-AC04-76DP-00789; SNL-57-6152)
(DE90-012010; SAND-89-7139) Avail: NTIS HC A06/MF A01

The overall objective of this program was to investigate the loss mechanisms in Si and GaAs solar cells and to provide guidelines for improving the performance. Major emphasis was placed in the following two areas: (1) modeling and quantifying the effect of trap location and light trapping on cell performance, and (2) determining the loss mechanisms in experimental cells through a combination of device and materials characterization and detailed modelling of device characteristics (illuminated and dark current-voltage characteristics and spectral response). Optimal design of solar cells was found to be very sensitive to the deep level. A program for analysis of various light-trapping geometries by means of ray-tracing calculations was begun. Finally, a novel thin base design is proposed for GaAs solar cells that can be more efficient and more tolerant of poor-quality material than present designs. DOE

N90-25430# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
BOILING/EVAPORATIVE HEAT TRANSFER FROM SPHERES IN PACKED-BED THERMAL ENERGY STORAGE UNITS Final Report
R. V. Arimilli and C. A. Moy May 1990 88 p Prepared for Oak Ridge National Lab., TN
(Contract DE-AC05-84OR-21400)
(DE90-012023; ORNL/Sub-86-7685/2) Avail: NTIS HC A05/MF A01

An experimental study was conducted to study boiling/evaporative heat transfer from heated spheres in vertical packed beds with downward liquid vapor flow of Refrigerant-113. Surface superheats of 1 to 50 C; mass flow rates of 1.7, 2.7, and 5.6 kg/min; sphere diameters of 1.59 and 2.54 cm; quality (i.e., mass fraction of vapor) of the inlet flow of 2 to 100 percent; and two surface roughness conditions were considered. To determine heat transfer coefficients, smooth and roughened aluminum spheres of the same diameter as the other spheres in the bed were instrumented with two thermocouples each for measuring the surface temperatures and a tiny electrical resistance heater for input power. The heat transfer measurements were made under steady-state conditions. Heat transfer coefficients were independently determined for each sphere at three values of surface superheat. The quantitative results are represented as a correlation for the boiling heat transfer coefficients in terms of a homogeneous model. The equation correlates very effectively with the dimensionless temperature difference. The correlation may be used in the development of numerical models to simulate the transient thermal performance of a packed-bed thermal energy storage unit while operating as an evaporator. The boiling of the liquid vapor flow around the spheres in the packed bed was visually observed with a fiber optic boroscope and recorded on a video tape. The visualization results showed qualitatively the presence of our four distinct flow regimes. One of these occurs under subcooled regime. The other three occur under saturated inlet conditions and are referred to as the low-quality, medium-quality, and high-quality regimes. The regimes are discussed in detail. DOE

N90-25431# Sandia National Labs., Albuquerque, NM.
PERFORMANCE TESTING AND QUALIFICATION OF SANDIA'S THIRD BASELINE PHOTOVOLTAIC CONCENTRATOR MODULE
Elizabeth H. Richards, Clement J. Chiang, and Michael A. Quintana 1990 6 p Presented at the 21st IEEE Photovoltaic Specialists Conference, Kissimmee, FL, 21-25 May 1990
(Contract DE-AC04-76DP-00789)
(DE90-012644; SAND-90-1260C; CONF-900542-10) Avail: NTIS HC A02/MF A01

Sandia designed, built, and tested prototypes of a new photovoltaic concentrator module, the Sandia Baseline Module 3 (SBM3). The SBM3 is intended to be a high-efficiency module that can be readily adapted for commercial production. It consists of a 2 by 12 parquet of lenses arranged with 24 cells in an aluminum housing. The geometric concentration ratio is 185. The cells were made at the University of New South Wales and employ prismatic covers designed by ENTECH. The module features a new concept in cell assemblies in that the cells are soldered directly to a copper heat spreader, eliminating the expensive ceramic wafer and heat sink that have been used in previous designs. Electrical isolation was accomplished by anodizing and electrophoretically coating the aluminum housing. Lessons learned during construction and testing of the SBM3 are presented, along with the outdoor performance characteristics of prototype modules and results from qualification testing. DOE

N90-25558*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SOLAR ARRAY ARCING IN PLASMAS
Dale C. Ferguson *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 509-513 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10A

N90-25559*# Air Force Geophysics Lab., Hanscom AFB, MA.
PHOTOVOLTAIC ARRAY SPACE POWER PLUS DIAGNOSTICS EXPERIMENT
Donald A. Guidice *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 515-519 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10A

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N90-25432# Health Effects Research Lab., Research Triangle Park, NC.
TOOLS FOR MAPPING ENVIRONMENTAL MONITORING DATA
Wilson B. Riggan, L. T. Heiderscheit, John P. Creason, and Alvin C. Pellam (Integrated Lab. Systems, Research Triangle Park, NC.) 1990 9 p
(PB90-129685; EPA/600/D-89/210) Avail: NTIS HC A02/MF A01 CSCL 13B

A data presentation tool for use with a variety of types of data which may contain spatial and temporal patterns of interest is briefly described. The technology links mainframe computing power to the new generation of desktop publishing hardware and software to produce publication-quality maps and tables. Maps of air pollution data have been generated which show spatial and temporal patterns for emissions as well as ambient air quality levels, using a Macintosh 2 computer with a laser printer. Author

N90-25433# National Center for Atmospheric Research, Boulder, CO.
PHYSICAL PARAMETERIZATION OF SNOW ALBEDO FOR USE IN CLIMATE MODELS Ph.D. Thesis
S. E. Marshall Nov. 1989 177 p Prepared in cooperation with Washington Univ., Seattle Sponsored by NSF
(PB90-167313; NCAR/CT-123) Avail: NTIS HC A09/MF A01 CSCL 13B

The albedo of a natural snowcover is highly variable ranging from 90 percent for clean, new snow to 30 percent for old, dirty snow. The range in albedo represents a difference in surface energy absorption of 10 to 70 percent of incident solar radiation. Most general circulation models fail to calculate the surface snow albedo accurately, yet the results of these models are sensitive to the assumed value of the snow albedo. The current simple empirical parameterization of snow albedo is replaced with a physically-based parameterization which is accurate (within + or - 3 percent of theoretical estimates) yet efficient to compute. The parameterization is designed as FORTRAN subroutine (called SNOALB) which can be easily implemented into model code. GRA

N90-25434# Air Force Academy, CO. Library.
MANAGING THE GLOBAL ENVIRONMENT
Louis C. Bassetti, Sue E. Neufeld, and Frances K. Scott Jan. 1990 56 p
(AD-A218615; Special-BIB-Ser-79) Avail: NTIS HC A04/MF A01 CSCL 13/2

This document consists of a bibliography on the following topics: Environmental issues and problems; Politics and economics of the environment; Managing the environment -- Past practice; Present and future efforts. GRA

N90-25435# Acurex Corp., Research Triangle Park, NC. Environmental Systems Div.
A LOW NOx STRATEGY FOR COMBUSTING HIGH NITROGEN CONTENT FUELS
Ravi K. Srivastava Jan. 1990 72 p
(Contract EPA-68-02-3988)
(PB90-155664; EPA/600/7-90/002) Avail: NTIS HC A04/MF A01 CSCL 13B

Results are given for an evaluation of a multistaged combustion burner (designed for in-furnace NOx control and high combustion efficiency) for high nitrogen content fuel and waste incineration application in a 1.0 MW package boiler simulator. A low NOx precombustion chamber burner was reduced in size by about a factor of two (from 600 to 250 ms first-stage residence time) and coupled with air staging, resulting in a three-stage configuration, and natural gas fuel staging, yielding up to four stoichiometric zones. Natural gas, doped with ammonia to yield a 5.8 percent fuel nitrogen content, and distillate fuel oil, doped with pyridine to yield a 2.0 percent fuel nitrogen content, were used to simulate high nitrogen content fuel/waste mixtures. Under the conditions tested, net chemical destruction of NO via reburning does not seem to be evident. This may be due to the existence of rather low primary NO concentrations before the application of reburning. However, a beneficial dilution caused by reburning may provide lower NO emissions. GRA

N90-25436# University of Southern California, Los Angeles. Corrosion and Environmental Effects Lab.
THE EFFECTS OF ACID FOG AND DEW ON MATERIALS Final Report
F. Mansfield, R. Henry, and R. Vijayakumar (CE Environmental, Camarillo, CA.) Oct. 1989 90 p
(Contract ARB-A5-138-32)
(PB90-157496; ARB-R-89/425) Avail: NTIS HC A05/MF A01 CSCL 13B

Field exposure tests were carried out in order to separate the effects of acidic fog on materials damaged from those caused by rain, dew and natural weathering. The test sites were McKittrick and Visalia in the Central Valley and West Casitas Pass in Ventura County. The field tests were supported by laboratory tests in which materials damage was determinined during exposure to carefully controlled fog water chemistry. Analysis of the field exposure results for galvanized steel and the paint samples shows that the corrosivity of the atmosphere at the three test sites were very low. The result is confirmed by the ACRM data which show very low corrosion activity. Since corrosion rates were so low approaching those for natural weathering, it was not possible to determine the effects of acidic fog. Based on the aerometric data and the observed corrosion behavior, it is doubtful that acidic fog conditions prevailed for significant times during the exposure period of Jan. 1987 to Mar. 1988 at Visalia and McKittrick. The results of the laboratory tests show that exposure to HNO3 at low pH and to high pollutant concentration increased the corrosion rate of galvanized steel to over 10 micro m/year. Exposure to HNO3 caused serious corrosion damage to anodized aluminum and the paint. GRA

N90-25437# DGA, Inc., Ventura, CA.
SOUTHERN CALIFORNIA AIR QUALITY STUDY: TOXIC AIR CONTAMINANTS, TASK 1 Final Report
Mohamed W. M. Hisham and Daniel Grosjean Jan. 1990 113 p
(Contract ARB-A-832-152)
(PB90-171570; ARB-R-90/431) Avail: NTIS HC A06/MF A01 CSCL 13B

As part of the Southern California Air Quality Study (SCAQS), intensive measurements of peroxyacetyl nitrate (PAN) were carried out by electron gas chromatography (EC-GC). Under the conditions employed for PAN measurements, all chromatograms of ambient air recorded during SCAQS also contained information on ambient levels of toxic chlorinated hydrocarbons. The objective was to retrieve this information, i.e., to identify these chlorinated hydrocarbons to carry out EC-GC lab calibrations under conditions identical to those used during SCAQS, and to use the calibration data to calculate ambient levels of toxic chlorinated hydrocarbons during SCAQS. Author

N90-25438# Midwest Research Inst., Golden, CO.
THE EFFECTS OF URBAN AIR POLLUTION ON SOLAR RADIATION
Carol J. Riordan, T. L. Stoffel, and Roland L. Hulstrom Dec.

1989 38 p
(Contract DE-AC02-83CH-10093)
(DE89-009455; SERI/TR-215-3482) Avail: NTIS HC A03/MF A01

This report contains results of a study examining the effects of urban air pollution on total and spectral solar radiation resources. Researchers reviewed past studies and made measurements during eleven days at an urban site and a nonurban reference site near Denver, Colorado. The measurement period overlapped with the 1987 to 1988 Metro Denver Brown Cloud Study, which provided supporting atmospheric chemistry, visibility, and meteorological data. Based on past studies, investigators expected increased scattering of solar radiation, mainly by fine-particle sulfate, nitrate, and carbon, and increased absorption by nitrogen dioxide, ozone, and elemental carbon at the urban site. Measurements confirmed an increase in the scattering of solar radiation at the urban site. Researchers could not separate extinction due to nitrogen dioxide, ozone, and elemental carbon from extinction due to scattering.
DOE

N90-25439 Institut d'Aeronomie Spatiale de Belgique, Brussels.
DIVERSIFORM PROCESSES OF OZONE IN THE ATMOSPHERE: INTRODUCTION STUDY [PROCESSUS DIVERSIFORMES DE L'OZONE DANS L'ATMOSPHERE: UNE INTRODUCTION A LEUR ETUDE]
Marcel Nicolet 1990 51 p In FRENCH; ENGLISH summary Submitted for publication
(Aeronomica-Acta-A-352-1990; ISSN-0065-3713; ETN-90-97025)
Avail: Institut d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

The ways for determining the ozone variations in the atmosphere are investigated. The dependence of the measurement accuracy and the reliability of the results on fundamental parameters relating to observation, experiments and theory are discussed. The influence of the following phenomena is taken into account: the solar radiation, the tropopause variations of height, the calculations of the exchanges between troposphere and stratosphere, the photodissociation of oxygen and ozone. It is demonstrated that an exact knowledge of atmospheric parameters is still required.
ESA

N90-25440 Institut d'Aeronomie Spatiale de Belgique, Brussels.
ANTHROPOGENIC SOURCES OF NO(x), SO()X, CO, AND CH4: GEOGRAPHICAL DISTRIBUTION
J. F. Mueller 1990 25 p Sponsored by Belgian Fonds National de la Recherche Scientifique
(Aeronomica-Acta-A-353-1990; ISSN-0065-3713; ETN-90-97026)
Avail: Institut d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

Available energy and industry statistics from different international organizations were used, together with various results from recent publications to produce world maps of the anthropogenic emissions of NOx (nitrogen oxides), SOx (sulfur oxides), CO (carbon monoxide) and CH4 (methane). These emissions are distributed into a 5 by 5 deg resolution latitude-longitude grid, suitable for use in a three dimensional chemical/transport model of the atmosphere.
ESA

N90-25405# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Atmospheric Physics.
AIRBORNE CHEMISTRY MEASUREMENTS
Dieter Paffrath *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 43-49 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N90-25441*# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
THE DEVELOPMENT OF THE JULY 1989 1 DEG X 1 DEG AND 30' X 30' TERRESTRIAL MEAN FREE-AIR ANOMALY DATA BASES
Jeong-Hee Kim and Richard H. Rapp Jan. 1990 103 p
(Grant NGR-36-008-161)
(NASA-CR-186475; NAS 1.26:186475; Rept-403) Avail: NTIS HC A06/MF A01 CSCL 04A

In June 1986 a 1 x 1 deg/mean free-air anomaly data file containing 48955 anomalies was completed. In August 1986 a 30 x 30 min mean free-air anomaly file was defined containing 31787 values. For the past three years data has been collected to upgrade these mean anomaly files. The primary emphasis was the collection of data to be used for the estimation of 30 min means anomalies in land areas. The emphasis on land areas was due to the anticipated use of 30 min anomalies derived from satellite altimeter data in the ocean areas. There were 10 data sources in the August 1986 file. Twenty-eight sources were added based on the collection of both point and mean anomalies from a number of individuals and organizations. A preliminary 30 min file was constructed from the 38 data sources. This file was used to calculate 1 x 1 deg mean anomalies. This 1 x 1 deg file was merged with a 1 x 1 deg file which was a merger of the June 1986 file plus a 1 x 1 deg file made available by DMA Aerospace Center. Certain bad 30 min anomalies were identified and deleted from the preliminary 30 min file leading to the final 30 min file (the July 1989 30 min file) with 66990 anomalies and their accuracy. These anomalies were used to again compute 1 x 1 deg anomalies which were merged with the previous June 86 DMAAC data file. The final 1 x 1 deg mean anomaly file (the July 89 1 x 1 deg data base) contained 50793 anomalies and their accuracy. The anomaly data files were significantly improved over the prior data sets in the following geographic regions: Africa, Scandinavia, Canada, United States, Mexico, Central and South America. Substantial land areas remain where there is little or no available data.
Author

N90-25442*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.
BERMUDA IONOSONDE TESTS IN SUPPORT OF OTH-B
David F. Kitrosser, Klaus Bibl, Jane Tang, and Terence W. Bullett Jul. 1988 28 p Prepared in cooperation with Northwest Research Associates, and Lowell Univ., MA
(Contract F19628-87-C-0003)
(NASA-TM-89359; NAS 1.15:89359; AD-A221315; GL-TR-89-0182; SR-11; ULRF-452/CAR) Avail: NTIS HC A03/MF A01 CSCL 04/1

Through evaluation of low power test results obtained during low power tests conducted on the Digisonde at Wallops Flight Facility, the RFI committee established that further testing was required prior to authorization of permanent installation of the Digisonde 256 on NAS Bermuda in support of the East Coast OTH-B radar system. As a result, a site survey was required to identify an acceptable location for locating the Digisonde 256 with follow-on temporary deployment of a Digisonde 256 and performance of a two week operational low power test and follow-on evaluation. The low power tests and evaluation were required to confirm: (1) that low power ionosonde transmissions would not provide interference to Bermuda military or commercial HF users; and (2) that acquisition of received ionospheric echoes is sufficient to adequately support the Automated Real Time Ionogram Scaler with True Height (ARTIST).
Author

N90-25443*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE DETERMINATION OF THE ORBIT OF THE JAPANESE SATELLITE AJISAI AND THE GEM-T1 AND GEM-T2 GRAVITY FIELD MODELS
Braulio V. Sanchez Jun. 1990 23 p
(NASA-TM-100763; Rept-90E02466; NAS 1.15:100763) Avail: NTIS HC A03/MF A01 CSCL 08G

The Japanese Experimental Geodetic Satellite Ajisai was launched on August 12, 1986. In response to the TOPEX-POSEIDON mission requirements, the GSFC Space Geodesy Branch and its associates are producing improved models of the Earth's gravitational field. With the launch of Ajisai, precise laser data is now available which can be used to test many current gravity models. The testing of the various gravity field models show improvements of more than 70 percent in the orbital fits when using GEM-T1 and GEM-T2 relative to results obtained with the earlier GEM-10B model. The GEM-T2 orbital fits are at the 13-cm level (RMS). The results of the tests with the various versions of the GEM-T1 model indicate that the addition of satellite altimetry and surface gravity anomalies as additional data types should improve future gravity field models. Author

N90-25444*# Aerospace Corp., El Segundo, CA. Space Sciences Lab.
A STUDY OF THE SPATIAL SCALES OF DISCRETE POLAR AURORAL ARCS
David J. Gorney 15 Jun. 1989 17 p
(Grant NAGw-853)
(NASA-CR-186806; NAS 1.26:186806; ATR-88(7162)-3) Avail: NTIS HC A03/MF A01 CSCL 04A

Recent theoretical works have dealt with the identification and evaluation of the physical processes that determine the characteristic scale sizes of discrete auroral arcs. It is broadly acknowledged that a characteristic spatial width of approximately 100 km (at ionospheric heights) results naturally from the ionospheric mapping of the high-altitude magnetospheric convection electric field. However, recent analysis of the spatial power spectral distributions of electric and magnetic field variations has revealed structure at much smaller spatial scales. In this analysis, precipitating auroral electron data from the J-package sensor on the Defense Meteorological Satellite Program satellite is used to study the spatial scale sizes and size distributions of polar auroral arcs. A monotonically decreasing inverse-wavelength spectrum with a slope near unity is common, with no strictly preferred scale sizes, although the scale spectrum does flatten at scales larger than approximately 100 to 200 km. Typical observed widths of the auroral arcs tend to be much smaller than the resistive scale length, and the observed widths do not have a strong dependence on local ionospheric parameters. Author

N90-25445# Swedish Inst. of Space Physics, Kiruna.
ELECTRON POPULATIONS ABOVE THE NIGHTSIDE AURORAL OVAL DURING MAGNETIC QUIET TIMES
Ingrid Sandahl and Per-Arne Lindqvist (Royal Inst. of Tech., Stockholm, Sweden) Mar. 1990 38 p Submitted for publication Sponsored by Swedish Board for Space Activities and Royal Inst. of Technology, Sweden
(Grant NSF ATM-88-03133)
(IRF-Preprint-116; ETN-90-97037) Avail: NTIS HC A03/MF A01

The electrons between 2000 and 13500 km altitude above the nightside auroral oval during magnetic quiet times were investigated. Electrons were classified into two populations, structured electrons with characteristic energies below 1 keV and unstructured electrons. The unstructured electrons were further classified into isotropic and trapped particles; the isotropic ones are poleward of the trapped ones. The spatial regions where these regions continued into the day side, dayside data were included in the study. It was found that the spatial regions of both structured and unstructured electrons form continuous belts. The average latitude of the structured electrons was higher than the average latitude of unstructured electrons. The regions partially overlapped at all magnetic local times except noon. Conclusions are drawn about the electron sources of the different regions by studying their plasma properties and their mapping into the magnetosphere using the Tsyganenko (1987) model and by comparing with other studies. ESA

N90-25446# Norwegian Defence Research Establishment, Kjeller.
PRELIMINARY RESULTS FROM THE QUADRUPOLE PROBE ON NEED-1
Knut Svenes and Jan Troim 3 Nov. 1989 29 p
(FFI-89/7015; ISSN-0802-2437; ETN-90-97108) Avail: NTIS HC A03/MF A01

The sounding rocket NEED-1 (Nonmaxwellian Electron Energy Distributions) was launched in Nov. 1989. It was equipped with several plasma probes, particle counters and field probes. Possible wave-particle interactions between the ambient ionosphere and the auroral beams are studied. Launch criteria was determined by monitoring EISCAT measurements in real time. The results of the analysis of data from the quadrupole probe are presented. The emphasis is placed on empirical description of the measurements. ESA

N90-25404# Laboratoire de Meteorologie Dynamique du CNRS, Palaiseau (France).
EARTH RADIATION BUDGET MEASUREMENTS FROM SPACE
Robert Kandel *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 35-42 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

N90-25410# Joanneum Research Centre, Graz (Austria). Inst. for Digital Image Processing and Computer Graphics.
GEOCODED SPACEBORNE SAR PRODUCTS FOR GEOLOGICAL APPLICATIONS
Manfred F. Buchroithner *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 95-103 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

N90-25411# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.). Div. of Atmospheric Chemistry.
GLOBAL CHANGES IN TROPOSPHERIC CHEMISTRY
Paul J. Crutzen *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 105-113 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

N90-25412# Technische Univ., Graz (Austria). Inst. of Theoretical Geodesy.
SOLID EARTH, GRAVITY FIELD AND ENVIRONMENT
Hans Suenkel *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 115-123 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N90-25447# National Oceanic and Atmospheric Administration, Washington, DC. Office of Research and Applications.
RESEARCH PROGRAMS: METEOROLOGICAL PREDICTION. OCEANIC PROCESSES. CLIMATE AND GLOBAL CHANGE MONITORING. SATELLITE INSTRUMENTATION AND CALIBRATION
Oct. 1989 144 p Original contains color illustrations
Avail: NTIS HC A07/MF A01

Research projects of the National Environmental Satellite, Data,

and Information Service (NESDIS) are summarized from their beginning with the launch of weather satellite TIROS-1 on April 1, 1960. NESDIS, part of the National Oceanic and Atmospheric Administration (NOAA), operates the civil polar-orbiting and geostationary satellite systems for the collection of environmental data. Since 1960, successive satellites in the Improved Tiros Operational Satellite (ITOS) program have grown in sophistication, and now include concurrent multiple-channel sensing on a daily basis. The Geostationary Operational Environmental Satellite (GOES) program began in 1974. GOES satellites collect visible and infrared imagery at half-hour intervals. These images can be animated, either photographically or electronically, to provide a continuous view of atmospheric and oceanic features. Recent GOES spacecraft have carried experimental multiple channel sensors that measure atmospheric water vapor, temperature, and carbon dioxide. New spacecraft sensors, algorithms for data processing and enhancement, as well as operational analysis and applications techniques keep improving the utility of satellite data for meteorological predictions, the study of oceanic processes, monitoring resources, climate, and global environmental changes. Many of these projects are described. J.P.S.

N90-25448*# Purdue Univ., West Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
STUDIES IN THE PARAMETERIZATION OF CLOUDINESS IN CLIMATE MODELS AND THE ANALYSIS OF RADIATION FIELDS IN GENERAL CIRCULATION MODELS Final Technical Report, 1 Oct. 1988 - 31 Dec. 1989
Harshvardhan 1 Mar. 1990 27 p
(Grant NAG5-1088)
(NASA-CR-186378; NAS 1.26:186378) Avail: NTIS HC A03/MF A01 CSCL 04B

Broad-band parameterizations for atmospheric radiative transfer were developed for clear and cloudy skies. These were in the shortwave and longwave regions of the spectrum. These models were compared with other models in an international effort called ICRCCM (Intercomparison of Radiation Codes for Climate Models). The radiation package developed was used for simulations of a General Circulation Model (GCM). A synopsis is provided of the research accomplishments in the two areas separately. Details are available in the published literature. Author

N90-25449# Consultants Choice, Inc., Atlanta, GA.
ADVANCED MESOSCALE WEATHER FORECASTING TO SUPPORT TACTICAL OPERATIONS ON THE AIRLAND BATTLEFIELD Final Report, 1 Jul. 1988 - 31 Dec. 1989
Paul D. Lampru, Jr., Lee A. Atkinson, Marc Perrone, and Kenneth C. Young (ThinkNet, Inc., Tucson, AZ.) 28 Feb. 1990 122 p
(Contract DAAD07-88-C-0045)
(AD-A219421; CCI-G88-042-01) Avail: NTIS HC A06/MF A01 CSCL 04/2

The test and evaluation of a hybrid statistical neural net program called Goal-Oriented Pattern Detection (GOPAD) was developed along with a cloud tracking program that uses weather satellite imagery as input. Both technologies show great promise to provide better weather products to the tactical military user. GRA

N90-25450*# Colorado State Univ., Fort Collins.
SEA BREEZE: INDUCED MESOSCALE SYSTEMS AND SEVERE WEATHER Final Report
M. E. Nicholls, R. A. Pielke, and W. R. Cotton 21 Jun. 1990 15 p
(Grant NAG5-359)
(NASA-CR-186367; NAS 1.26:186367) Avail: NTIS HC A03/MF A01 CSCL 04B

Sea-breeze-deep convective interactions over the Florida peninsula were investigated using a cloud/mesoscale numerical model. The objective was to gain a better understanding of sea-breeze and deep convective interactions over the Florida peninsula using a high resolution convectively explicit model and to use these results to evaluate convective parameterization schemes. A 3-D numerical investigation of Florida convection was completed. The Kuo and Fritsch-Chappell parameterization schemes are summarized and evaluated. Author

N90-25451*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
AN ATLAS OF ECMWF ANALYSES (1980-1987). PART 2: SECOND MOMENT QUANTITIES
S. Schubert, W. Higgins, C.-K. Park, S. Moorthi (Universities Space Research Association, Columbia, MD.), and M. Suarez Washington Jun. 1990 253 p
(NASA-TM-100762-Pt-2; Rept-90E02172; NAS 1.15:100762-Pt-2) Avail: NTIS HC A12/MF A02 CSCL 04B

This document is an atlas based on European Center for Medium Range Weather Forecasts (ECMWF) initialized analyses for 1980-1987. Transports and variance are presented globally at 200 and 850 mb as well as zonally averaged for seasonal and annual averages. Selected fields are filtered to isolate the synoptic (2.5 days is less than periods is less than 6 days) and low frequency (10 days is less than periods is less than 90 days) regions of the spectrum. In addition, time series of the zonally and monthly averaged transports and variances are presented over the entire 8 year period. Author

N90-25452*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ATMOSPHERIC ENVIRONMENT FOR SPACE SHUTTLE (STS-28) LAUNCH
G. L. Jasper and G. W. Batts (Computer Sciences Corp., Huntsville, AL.) Jul. 1990 42 p
(NASA-TM-100386; NAS 1.15:100386) Avail: NTIS HC A03/MF A01 CSCL 04B

A summary is presented of selected atmospheric conditions observed near Space Shuttle STS-28 launch time on August 8, 1989. STS-28 carried a Department of Defense payload and the flight azimuth is denoted by a reference flight azimuth, since the actual flight azimuth is not known. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), and winds aloft are included. The sequence of prelaunch Jimsphere-measured vertical wind profiles is given. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-28 vehicle ascent was constructed and represents the best estimate of the launch environment to 400,000 ft altitude that was traversed by the STS-28 vehicle. The STS-28 ascent atmospheric data tape was constructed by Marshall Space Flight Center's Earth Science and Applications Division to provide an internally consistent data set for use in post-flight performance assessments. Author

N90-25400# Centre National d'Etudes Spatiales, Paris (France). Direction des Programmes.
CNES SPACE PROGRAMMES RELATED TO CLIMATE
A. Ratier *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 7-16 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

N90-25401# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Atmospheric Physics.
CLOUD ANALYSIS WITH SATELLITE DATA Abstract Only
K. T. Kriebel *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 17 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

N90-25402# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Atmospheric Physics.
CLOUD DYNAMICS AND CLOUD MICROPHYSICS BY RADAR MEASUREMENTS
Peter Meischner *In* ESA, Remote Sensing and the Earth's

Environment Mar. 1990 p 19-26 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

N90-25403# Laboratoire de Meteorologie Dynamique du CNRS, Palaiseau (France).
EARTH RADIATION BUDGET AND CLIMATE
Robert Kandel *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 27-33 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N90-25406# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Optoelectronics.
OCEAN COLOUR: METHODS, TECHNOLOGIES, APPLICATIONS
Hans vanderPiepen *In* ESA, Remote Sensing and the Earth's Environment Mar. 1990 p 51-59 (For primary document see N90-25398 19-43)
Copyright Avail: NTIS HC A08/MF A01; also available from EPB, ESTEC, Noordwijk, Netherlands, 40 Dutch guilders

N90-25576*# Tulane Univ., New Orleans, LA. Dept. of Computer Science.
OCEAN FEATURE RECOGNITION USING GENETIC ALGORITHMS WITH FUZZY FITNESS FUNCTIONS (GA/F3)
C. A. Ankenbrandt, B. P. Buckles, F. E. Petry, and M. Lybanon (Naval Ocean Research and Development Activity, Bay Saint Louis, MS.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 679-685 (For primary document see N90-25503 19-59)
(Contract N00014-89-J-6003)
Avail: NTIS HC A99/MF A04 CSCL 08C

51 LIFE SCIENCES (GENERAL)

N90-25453*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
CARBON DIOXIDE AND WATER EXCHANGE RATES BY A WHEAT CROP IN NASA'S BIOMASS PRODUCTION CHAMBER: RESULTS FROM AN 86-DAY STUDY (JANUARY TO APRIL 1989)
R. M. Wheeler (Bionetics Corp., Cocoa Beach, FL.) and J. C. Sager Jan. 1990 30 p
(NASA-TM-102788; NAS 1.15:102788) Avail: NTIS HC A03/MF A01 CSCL 06C

Gas exchange measurements were taken for a 20 sq m wheat stand grown from seed to harvest in NASA's Biomass Production Chamber. Respiration of the wheat stand caused the CO2 concentrations to rise an average of 440 ppm during the 4-h dark period each day, or 7.2 umol/sq m/sec. Dark period respiration was sensitive to temperature changes and could be increased 70 to 75 percent by raising the temperature from 16 C to 24 C. Stand photosynthesis (measured from the rate of CO2 drawdown immediately after the lights came on each day) peaked at 27 umol/sq m/sec at 25 days after planting and averaged 15 umol/sq m/sec throughout the study. By combining the average light period photosynthesis and average dark period respiration, a net of 860 g or 470 liters of CO2 were fixed per day. Stand photosynthetic rates showed a linear increase with increasing irradiance (750 umol/sq m/sec PPF the highest level tested), with an average light compensation point after day 30 of 190 umol/sq m/sec. Stand photosynthesis decreased slightly when CO2 levels were decreased from 2200 to 800 ppm, but dropped sharply when CO2 was decreased below 700 to 800 ppm. Water production from stand transpiration peaked at 120 L/day near 25 days and averaged about 90 L/day, or 4.5 L/sq m/day throughout the study. Author

N90-25454# Southwest Foundation for Biomedical Research, San Antonio, TX.
PROGRAM REVIEW: THE LIFETIME EFFECTS OF SPACE RADIATION IN RHESUS MONKEYS Final Report, Mar. - Jul. 1989
Thomas M. Butler Mar. 1990 29 p
(Contract F33615-87-D-0627; AF Proj. 7757)
(AD-A221127; USAFSAM-TR-90-3) Avail: NTIS HC A03/MF A01 CSCL 06/18

Findings are summarized from a select panel of scientists charged with reviewing the quality and productivity of the USAFSAM 24-year in-house study of the lifetime effects of space radiation in the rhesus monkey. The panel also had the responsibility of assessing the value of the study in both military and civilian scientific applications and making recommendations for maximizing the yield of relevant data as the animals near the end of their life span. The panelists reviewed results presented by project scientists during a 2-day conference. They were unanimous in their endorsement of the study as a uniquely important resource of information on the late effects of space radiation and the interaction of late effects with the normal aging process. In asserting that the study should be continued for at least another 5 years, the panel made specific recommendations for additional work to be carried out in collaboration with scientists at other laboratories who could provide the breadth of technical expertise required to fully exploit the potential of this project. The scientific proceedings of the conference will be published as separate journal articles.
GRA

N90-25455*# Bionetics Corp., Cocoa Beach, FL.
UTILIZATION OF THE WATER SOLUABLE FRACTION OF WHEAT STRAW AS A PLANT NUTRIENT SOURCE
C. L. Mackowiak and J. L. Garland (Virginia Univ., Charlottesville.) Jun. 1990 27 p
(Contract NAS10-11624)
(NASA-TM-103497; NAS 1.15:103497) Avail: NTIS HC A03/MF A01 CSCL 06C

Recovery of water soluble, inorganic nutrients from the inedible portion of wheat was found to be an effective means of recycling nutrients within hydroponic systems. Through aqueous extraction (leaching), 60 percent of the total inorganic nutrient weight was removed from wheat straw and roots, although the recovery of individual nutrients varied. Leaching also removed about 20 percent of the total organic carbon from the biomass. In terms of dry weight, the leachate was comprised of approximately 60 percent organic and 40 percent inorganic compounds. Direct use of wheat straw leachate in static hydroponic systems had an inhibitory effect on wheat growth, both in the presence and absence of microorganisms. Biological treatment of leachate either with a mixed microbial community or the oyster mushroom Pleurotus ostreatus L., prior to use in hydroponic solutions, significantly reduced both the organic content and the inhibitory effects of the leachate. The inhibitory effects of unprocessed leachate appear to be a result of rapidly acting phytotoxic compounds that are detoxified by microbial activity. Leaching holds considerable promise as a method for nutrient recycling in a Controlled Ecological Life Support System (CELSS). Author

N90-25456*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
SYSTEM DEVELOPMENT AND EARLY BIOLOGICAL TESTS IN NASA'S BIOMASS PRODUCTION CHAMBER
R. M. Wheeler, C. L. Mackowiak, T. W. Dreschel, J. C. Sager, R. P. Prince, W. M. Knott, C. R. Hinkle, and R. F. Strayer (Bionetics

Corp., Cocoa Beach, FL.) Mar. 1990 30 p
(NASA-TM-103494; NAS 1.15:103494) Avail: NTIS HC A03/MF A01 CSCL 06C

The Biomass Production Chamber at Kennedy Space Center was constructed to conduct large scale plant growth studies for NASA's CELSS program. Over the past four years, physical systems and computer control software have been continually upgraded and the degree of atmospheric leakage from the chamber has decreased from about 40 to 5 percent of the total volume per day. Early tests conducted with a limited degree of closure showed that total crop (wheat) growth from the best trays was within 80 percent of reported optimal yields for similar light levels. Yields from subsequent tests under more tightly closed conditions have not been as good--up to only 65 percent of optimal yields. Yields appear to have decreased with increasing closure, yet potential problems exist in cultural techniques and further studies are warranted. With the ability to tightly seal the chamber, quantitative data were gathered on CO2 and water exchange rates. Results showed that stand photosynthesis and transpiration reached a peak near 25 days after planting, soon after full vegetative ground cover was established. In the final phase of testing when atmospheric closure was the highest, ethylene gas levels in the chamber rose from about 10 to nearly 120 ppb. Evidence suggests that the ethylene originated from the wheat plants themselves and may have caused an epinastic rolling of the leaves, but no apparent detrimental effects on whole plant function. Author

N90-25457* Lockheed Engineering and Sciences Co., Washington, DC.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 27
Lydia Razran Stone, ed., Ronald Teeter, ed., Victoria Garshnek, ed., and Joseph Rowe, ed. (Library of Congress, Washington, DC.) Washington NASA Jul. 1990 87 p
(Contract NASw-4292)
(NASA-CR-3922(32); NAS 1.26:3922(32)) Avail: NTIS HC A06/MF A01 CSCL 06B

This is the twenty-fifth issue of NASA's Space Life Sciences Digest. It contains abstracts of 30 journal papers or book chapters published in Russian and of 2 Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. The abstracts in this issue have been identified as relevant to 18 areas of space biology and medicine. These areas include: adaptation, aviation medicine, biological rhythms, biospherics, botany, cardiovascular and respiratory systems, endocrinology, enzymology, exobiology, habitability and environmental effects, hematology, immunology, metabolism, musculoskeletal system, neurophysiology, radiobiology, and space medicine. A Soviet book review of a British handbook of aviation medicine and a description of the work of the division on aviation and space medicine of the Moscow Physiological Society are also included. Author

N90-25458*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ECUT: ENERGY CONVERSION AND UTILIZATION TECHNOLOGIES PROGRAM. BIOCATALYSIS PROJECT
Annual Report, FY 1989
May 1990 85 p Prepared in cooperation with Department of Energy, Washington, DC
(Contracts NAS7-918; DE-A101-86CE-90239)
(NASA-CR-186866; NAS 1.26:186866; DOE/CS-66001/13)
Avail: NTIS HC A05/MF A01 CSCL 06B

The Biocatalysis Project is a mission-oriented, applied research and exploratory development activity directed toward resolution of the major generic technical barriers that impede the development of biologically catalyzed commercial chemical production. The approach toward achieving project objectives involves an integrated participation of Universities, Industrial Companies and Government Research Laboratories. The Project's technical activities were organized into three work elements: molecular modeling and applied genetics; bioprocess engineering; and bioprocess design and assessment. Author

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N90-25459# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.
NECK INJURY IN ADVANCED MILITARY AIRCRAFT ENVIRONMENTS
Feb. 1990 201 p In ENGLISH and FRENCH Symposium held in Munich, Fed. Republic of Germany, 24-28 Apr. 1989
(AGARD-CP-471; ISBN-92-835-0541-7) Copyright Avail: NTIS HC A10/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Anecdotal evidence suggests that soft tissue neck injury may be an occupational hazard for fighter pilots, particulary those in the later generation trainer and combat aircraft. Recent advances in helmet-mounted devices increase the potential for injury. There is an acute need for guidance on the maximum mass and mass distribution characteristics of head-mounted devices. The extent of risk and its control through the design of helmet-mounted devices, protective systems, and aircrew training and conditioning are discussed. For individual titles, see N90-25460 through N90-25479.

N90-25460# Air Force Medical Group (347th), Moody AFB, GA.
PREVALENCE OF G-INDUCED CERVICAL INJURY IN US AIR FORCE PILOTS
Rodger D. Venderbeek *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 7 p Submitted for publication (For primary document see N90-25459 19-52)
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Pilots of high performance aircraft are frequently exposed to significant accelerative forces; the effect of this exposure on the cervical vertebral column is an unquantified clinical and epidemiological problem. The findings are presented from a period of prevalence study of acute neck injury secondary to high G forces in U.S. Air Force pilots. A sample of 437 pilots of three different fighter aircraft was surveyed, and the data is stratified and analyzed to test the strength of association of injury prevalence with pilot age, type of aircraft, and type of flying environment. Results indicate that minor injury is common in these pilots, and that higher aircraft performance is associated with increased injury prevalence. Increased age is associated with increased prevalence of major cervical injuries. Preventive strategies may be helpful in reducing injury frequency and in avoiding serious injuries. Author

N90-25461# Nebraska Univ., Omaha. Dept. of Otolaryngology.
NON-EJECTION NECK INJURIES IN HIGH PERFORMANCE AIRCRAFT
David G. Schall *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 10 p (For primary document see N90-25459 19-52)
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The potential for significant neck injuries exists in today's high performance fighter aircraft. The G-loads required to produce injury need not be excessive, nor is experience level necessarily protective. Eight cervical spine injury cases, due to or aggravated by +G(sub z) in F-15 and F-16 aircrew members are reviewed. These include two compression fractures (C5/C7), three left HNP's (C5-6/C6-7), one fracture of the spinous process (C7), one interspinous ligament tear (C6-7), and one myofascial syndrome (C6). Mechanisms of injury and evaluation are discussed. Exercise conditioning may play an important role in prevention and protection. The role of screening x rays and improving equipment remain as areas where further work needs to be done. Author

N90-25462# Belgian Air Force, Beauvechain.
A SURVEY OF CERVICAL PAIN IN PILOTS OF A BELGIAN F-16 AIR DEFENCE WING
I. Biesemans, M. Ingels, and P. Vandenbosch (Belgian Air Force, Brussels.) *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 5 p (For primary document see N90-25459 19-52)
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Since the F-16 replaced the F-104 Starfighter in 1977, the pilots of the 1 deg Fighter Wing (1 deg FW) complained frequently from neck injuries sustained during and after their High + Gz interceptions. Until recently, Aerospace Medical community paid scant attention to this new clinical problem, although it was well known among pilots flying high performance aircraft (HPA) and flight surgeons. The results of an anonymous questionnaire, concerning neck problems in pilots flying the F-16 in an almost exclusive air to air role is communicated. A sample of 30 pilots answered these questionnaires in 1984 and in 1988. Analysis of these questionnaires showed 50 percent of the pilots reported having neck problems flying the F-16. No positive correlation between the age of the pilots and the prevalence of cervical pain could be demonstrated in this small group of fighter pilots. Subsequent factors in the neck injuries are the weight of the flying helmet as well as the combination of an inappropriate and insufficient physical training program. Neck injuries in pilots of HPA are a real occupational hazard and further long term follow up studies are needed to assess an eventually cumulative effect of repetitive high G loading on the cervical spine. Author

N90-25463# Royal Norwegian Air Force, Oslo. Inst. of Aviation Medicine.
RADIOLOGICAL INVESTIGATION OF THE VERTEBRAL COLUMN OF CANDIDATES FOR MILITARY FLYING TRAINING THE THE ROYAL NORWEGIAN AIR FORCE
Harald T. Andersen *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 6 p (For primary document see N90-25459 19-52)
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Neck injury with associated pain in the cervical spine and its supporting structures of ligaments and muscles are frequent complaints among aviators flying high performance fighter (HPF) aircraft. Two recent surveys conducted among air crew of the United States Air Force (USAF) and the United States Navy (USN), respectively, report incidences of neck pain incurred during flight of approximately 50 and 75 percent in these two HPF pilot populations (Knudsen et al., 1988, Vanderbeek 1988). Muscular pain, ruptured ligaments, sliding vertebrae and compression fractures were described resulting from violent manuevering during HPF air combat exercises (Andersen 1988). The cervical spinal column carries a heavy load during high-G accelerations supporting the head and various pieces of personal flying equipment. This top - heaviness is expected to increase further with night vision goggles and integrated weapon systems control devices added in an attempt to extend operable conditions. Moreover, since the aeromedical emphasis was on developments supporting cardio-vascular and respiratory functions, the neck and the delicate structures of vessels and nerves running with it are becoming increasingly vulnerable to damage. Literarily speaking, the neck has become pinched between the desire to add weight to the head for purposes other than protection, and, the support to cardio-vascular and respiratory organ systems which allows additional intensity and time spent during excursions into the high-G environment. For these reasons, and because the vertical column is relatively inaccessible to clinical examination, the medical selection procedures for military flying training with the Royal Norwegian Air Force (RNoAF) were extended some years ago to include a series of roentgen films of the vertebral column with emphasis on the cervical spine. Main findings and their consequences for admission to military flying training are presented. Author

N90-25464# Royal Norwegian Air Force, Oslo.
DATA ANALYSIS IN CERVICAL TRAUMA
Leif A. Levin, Harald T. Andersen, Leon E. Kazarian, Patrick Hayes, and Harald U. Sverdrup (Oslo Emergency Medical Center, Norway) *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 5 p (For primary document see N90-25459 19-52)
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The curvature of the cervical spine in lateral view is discussed and a method based on statistical analysis is used to reproduce quantitative data of the curvature. Part 1 is a study based on the lateral view in the neutral position in 142 aviators. The radiograms are divided in 3 main groups: normal cervical lordosis; marked straightening of the cervical spine; segmental straightening with reversal of the curve. Part 2 discusses the use of the digital analysis to determine the displacement in subjects that have sustained ligamentous injuries of the cervical spine following whiplash injury. Author

N90-25465# National Defence Medical Centre, Ottawa (Ontario). Rehabilitation Centre.
PROGRESSIVE CERVICAL OSTEOARTHRITIS IN HIGH PERFORMANCE AIRCRAFT PILOTS
Martin H. Gillen and Denis Raymond *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 6 p (For primary document see N90-25459 19-52)
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Thirty-one pilots who were subjected to a repetitive +G(sub z) environment were evaluated clinically and roentgenographically against age and sex-matched controls. Analyses demonstrated significant deterioration in the young pilot groups compared to controls in terms of neck range of motion, osteophytic spurring at C5/C6 and disc space narrowing at C4/5 and C5/6. While the pilots remain relatively asymptomatic during their flying career, they may be at greater risk for symptomatic cervical disease later in life. The +G(sub z) environment appears to play a role in an accelerated rate of cervical osteoarthritis in high performance pilots. This must be taken into consideration when systems that will increase the longitudinal impact load on the neck are being contemplated. Author

N90-25466# Amsterdam Univ. (Netherlands). Academisch Medisch Centrum.
ELECTRONYSTAGMOGRAPHIC FINDINGS FOLLOWING CERVICAL INJURIES
W. J. Oosterveld, H. W. Kortschot, G. G. Kingma, H. A. A. deJong, and M. R. Saatci *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 4 p (For primary document see N90-25459 19-52)
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The biomechanical model of the head-neck system pursuits a whole spectrum of movements in all planes of motion and for a variety of speeds. The muscle actions are constrained by the physical properties of the vertical column, whose articulations differ in their ranges and directions of mobility. This model has three types of elements: the flexible beams; the rigid mass of the head; and the neck muscle complex. Origins and insertions, axial rotation and muscle tensions can be approximated easily, so that the resulting peak static torques are compatible with the known torques generated voluntarily in various directions. All types of rotational movements can be performed with this construction, while the axis of rotation changes automatically with changing conditions. The neck muscle system has eight neural controller locations and eight locations for sensory feed-back. It is clear that the complicated

network of muscles and neural mechanisms makes the cervical area vulnerable to traumata. Among the blunt traumas to the cervical region are the acceleration-deceleration accidents, better known as cervical whiplash injuries. One hundred and seventy-three patients, suffering from the consequences of an acceleration accident of the neck were investigated during the last two years. All patients acquired the trauma at an automobile accident. The patients visited the department because of consistent complaints as headache, dizziness, tinnitus and visual disturbances. In all patients an ENT investigation, audiometry, vestibulometry and visual tracking tests were performed. Although all patients had the type of injury in common, combinations of complaints differed considerably. The results of the examinations are discussed.
Author

N90-25467# Naval Air Systems Command, Washington, DC. Escape Systems.
AIRCREW NECK INJURIES: A NEW, OR AN EXISTING, MISUNDERSTOOD PHENOMENON
Frederick C. Guill and G. Ronald Herd *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 12 p (For primary document see N90-25459 19-52)
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The first U.S. Navy ejection occurred on 9 August 1949. Since then, the Navy has experienced 4,335 ejections through March 1988. The first serious neck injury, a paracervical strain, associated with an ejection occurred on 20 February 1953. That injury, also, was the Navy's first vertebral/ paravertebral injury associated with ejection. Initially, assessment of such neck injuries was accomplished as simply another vertebral injury; however, in more recent years it has become more apparent that the cervical/paracervical injuries reported in connection with ejections do not exhibit the same pattern characteristics as other vertebral/paravertebral injuries. The injuries occur at different rates than would be expected based upon the rates of injury for other vertebral regions. Further, although a clear relationship between through-the-canopy ejection and higher incidence rates of vertebral injuries was established, (and a causal mechanism identified), that appeared not to be the case cervical/paracervical injuries. In addition, while vertebral/paravertebral injury incidence rates have fallen with the changes in catapult boost acceleration, cervical/paracervical injury incidence rates have steadily increased. Why cervical/paracervical injuries associated with ejection are increasing; why have they not declined as the injury incidence rates have for other spinal regions are examined. Anecdotal and statistical mishap data examined and compared in this and prior studies suggest that the answer might lie in the aircraft maneuvering capabilities and in the increased frequency of ejection during, or following, gyrations resulting from loss of control of aircraft. The answers obtained suggest that considerable caution needs to be exercised in the current trend to integrate manifold systems elements into aircrew helmets, especially in light of the man-limited capabilities of today's modern tactical aircraft. Author

N90-25468# Duke Univ., Durham, NC. Dept. of Biomedical Engineering.
FLEXION, EXTENSION AND LATERAL BENDING RESPONSES OF THE CERVICAL SPINE
James H. McElhaney, Brian J. Doherty, Jacqueline G. Paver, Barry S. Myers, and Linda Grey *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 10 p (For primary document see N90-25459 19-52)
(Grant R49/CCR402396-02)
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The lateral, anterior, and posterior passive bending responses of the human cervical spine were investigated using unembalmed cervical spinal elements obtained from cadavers. Bending stiffness was measured in six modes ranging from tension- extension through compression-flexion. A five-axis load cell was used to establish the end conditions. Results include moment-angle curves, relaxation moduli and the effect of cyclic conditioning on bending stiffness. The Hybrid 3 ATD neck was also tested and its responses are compared with the human. It was observed that the Hybrid 3 neck was more rate sensitive than the human, that mechanical conditioning significantly changed the stiffness of the human specimens, and that changing the end-condition from pinned-pinned to fixed-pinned increased the stiffness by a large factor. The bending stiffness was significantly influenced by the direction of the bending moment, the type of end restraint, the magnitude of the deformation and the previous deformation history. The shear force produced by the end conditions was an important factor in the applied moment. This shear force not only changes the moment acting on the specimen but also influences the failure mode. These experiments indicate that when the loading is eccentric (as it almost always is), the primary deformation mode is bending, and the moment applied to the specimen is strongly influenced by shear forces and the magnitude of the eccentricity. The axial load is therefore a poor indicator of the type and magnitude of failure stresses. MR and CT was used to visualize the damage after loading. When compared to the dissection results MR was clearly superior to CT in detecting soft tissue and ligamentous injuries.
Author

N90-25469# Naval Biodynamics Lab., New Orleans, LA.
A KINEMATIC/DYNAMIC MODEL FOR PREDICTION OF NECK INJURY DURING IMPACT ACCELERATION
Marc S. Weiss, S. J. Guccione, Jr., and Terry A. Watkins (New Orleans Univ., LA.) *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 6 p (For primary document see N90-25459 19-52)
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A statistical study was made of six head kinematic response curves for a set of 57 human and 29 animal (rhesus) -X impact acceleration tests conducted at the Naval Biodynamics Laboratory. The acceleration levels ranged from six to fifteen g's for humans and 42 to 106 g's for animals. The six analyzed responses included the X and Z components of the linear acceleration and displacement and the Y axis angular acceleration and displacement. Each head kinematic response variable was nonlinearly regressed on sled acceleration profile and head orientation parameters. Regression equations for rhesus and human kinematics had the same exponential functional form with correlations ranging from 0.50 to 0.95. Statistical measures of goodness-of-fit were highly significant. The results confirm that the rhesus head/neck is a good biomechanical model for the human. Extension of this approach can lead to the scaling of kinematics between humans and animals which can be used to develop an injury prediction model for humans. Future applications include re-analysis of previous results on the effects of mass distribution parameters on head/neck dynamic response.
Author

N90-25470# Erasmus Univ., Rotterdam (Netherlands). Dept. of Biomedical Physics.
ANALYSIS OF THE BIOMECHANIC AND ERGONOMIC ASPECTS OF THE CERVICAL SPINE UNDER LOAD
C. J. Snijders and E. R. Roosch (Royal Netherlands Air Force, Soesterberg.) *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 8 p (For primary document see N90-25459 19-52)
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In high performance aircraft complicated loading situations arise, e.g., when the head of the flier is turned backwards and rapid accelerations appear. To obtain more insight in the forces on the cervical spine a spatial biomechanical computer model was introduced. The research started with the development of a kinematic model which imposes the axes of rotation and mutual position of head and vertebrae in relation to flexion, extension, lateroflexion, and torsion. Subsequently lines of action of muscle

forces were introduced as well as external loads acting on the center of mass of head and helmet born by gravity and by accelerations in different directions. Measurements were carried out of accelerations and head positions during several flights, a.o. representing air combat. Next, with the help of the biomechanical model, forces in vertebrae and muscles could be estimated. Although in the present stage of the research results of calculations must be interpreted carefully, conclusions can be drawn with respect to sitting posture, head position and helmet devices. Maximal forces calculated appear to be rather high. However, too few data on failure behavior exist to draw conclusions as to (long term) detrimental effects. Author

N90-25471# Calspan Corp., Buffalo, NY.
EFFECTS OF HEAD MOUNTED DEVICES ON HEAD-NECK DYNAMIC RESPONSE TO +G(SUB z) ACCELERATIONS
Eberhardt Privitzer and Ints Kaleps (Aerospace Medical Research Labs., Wright-Patterson AFB, OH.) *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 14 p (For primary document see N90-25459 19-52)
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An investigation is described which addresses the inertial loading effects of Head Mounted Device (HMD) on aviator head-neck-spine dynamic response during high +G(sub z) acceleration exposure. The primary objectives were to develop a methodology which could be used to establish limits on HMD inertial properties and to apply this methodology to the evaluation of the severity of the internal loads (occurring in the neck and upper spine) associated with certain specific HMD ensembles. The Head-Spine Model (HSM), a highly discretized, 3-D mathematical representation of the human head-spine-torso structure, was used to: establish a set of baseline response criteria (BRC); establish a preliminary methodology for setting limits on HMD inertial properties; and evaluate the severity of the loading associated with possible chemical defense (CD) ensembles. Author

N90-25472# Paris V Univ. (France). Lab. d'Anthropologie Appliquee.
DYNAMICAL MODIFICATIONS TO THE HEAD, LOAD FACTORS FROM ADDITIONAL WEIGHT [MODIFICATION DE LA DUNAMIQUE DE LA TETE, CHARGEE PAR DES MASSES ADDITIONNELLES]
P. Y. Hennion, A. Coblentz, and R. Mollard *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 8 p In FRENCH (For primary document see N90-25459 19-52)
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Numerous devices impose upon the user added weight on the head. Their use is almost a technical requirement. It is rare that the restrictions caused by their use is considered at their conception. This idea was studied for a commonly used system. For the first time, the location of the center and moment of inertia was studied by a experimental method. The change in the inertia parameters of a head with a device which adds weight was precisely followed in an analysis of the movement of the center of inertia and the various moments of weight on a bare head, and in relation to the center of rotation which remains unchanged. The influence of added weight was observed on four subjects with motion measured and identified as defined by target sighting which caused the head to rotate in many directions without added weight. From a dynamical aspect, some variations in the level and duration of the rotation acceleration were raised in relation to the increase of inertia. The offset of the center of inertia was also induced by the vertical acceleration perturbation. This was confirmed by an increase of activity in cervical neck muscles, and from movement of the head by use of muscles in the nape of the neck. Another observation of lesser import was obvious, the interference caused by the introduction of devices for the maintenance of posture. Some strong variations were seen in stabilograms while target sighting when in an upright position. This change in head dynamics leads to a perceptable loss of performance, as seen by errors and an increased response time in the sighting of aerial targets. Equipment designers do not think of operator efficiency when adding weight to the head with helmet mounted devices. It is established in this study that the functional senses of the operator must be considered as well as the increased inertia and performance criteria. Transl. by E.R.

N90-25473# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France). Centre d'Essais en Vol.
MOBILITY OF THE HEAD AND LOAD EFFECTS: EXPERIMENTAL APPROACH IN A CENTRIFUGE [MOBILITE DE LA TETE ET FACTEUR DE CHARGE: APPROCHE EXPERIMENTALE EN CENTRIFUGEUSE]
A. Leger, P. Sandor, J. M. Clere, and G. Ossard *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 8 p In FRENCH (For primary document see N90-25459 19-52)
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The environment of modern combat pilots is very hazardous for the head-neck systems. The introduction of helmet mounted optronic systems caused even more problems with high G acceleration. Studies in centrifuges were used in order to show the influence of some environmental parameters (tilt of seat, high G and variations of acceleration forces) on head mobility. Two hundred and eighty centrifugal turns were made without causing traumatic injuries. The results show that up to 5 G, the head movements are changed very little. However, variations in the level of acceleration bring about perturbations of stability. The subsystems reflexes involved in head stabilization are influenced by voluntary control, these optional controls during aviation combat will be able to establish points of interest in the study of physiopathology of the pilot head-neck system. Transl. by E.R.

N90-25474# German Air Force, Fuerstenfeldbruk (Germany, F.R.). Inst. of Aerospace Medicine.
NECK INJURY PREVENTION POSSIBILITIES IN A HIGH-G-ENVIROMENT EXPERIENCE WITH HIGH SUSTAINED +G(SUB z) TRAINING OF PILOTS IN THE GAF IAM HUMAN CENTRIFUGE
W. H. Wurster, J. Langhoff, and E. C. Burchard *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 6 p (For primary document see N90-25459 19-52)
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New generations of high performance military aircraft are able to produce higher G-rates of onset, attain higher G-levels for prolonged periods and in the future will confront man and machine more often with changing acceleration peaks than previous fighter generations have. These enhanced performance capabilities will require additional anti-G protection equipment as well as special education and training of pilots to tolerate high-G environment levels so they can fulfill complex tasks during special inflight conditions without suffering from G-induced cardiovascular, pulmonary, cerebral or musculoskeletal problems. Therefore an extensive study in 238 young G-stress unexperienced pilot candidates (aged between 18 to 24 years) of the GAF - Officers' - Academy was performed within a period of 23 months (1 Oct. 1985 to 1 Sep. 1987) who participated in a high-G training program as volunteers with more than 1250 centrifuge rides partially up to +8 G(sub z) for 30 sec on the GAF IAM Human Centrifuge. By means of an anonymous questionnaire answered by the pilot candidates immediately after G(sub z) exposure and post-acceleration check-up, different data were obtained. The intention of this investigation was in maintaining vision and consciousness as well as neck injury prevention at high sustained +G(sub z) levels in G-unexperienced pilot candidates. The findings in the search for methods to protect a subject under +G(sub z)

stress in the human centrifuge from G-induced symptoms, especially of potential cervical spine problems, are described.
Author

N90-25475# Association Peugeot-Renault, Nanterre (France). Lab. de Physiologie et de Biomecanique.
RISK OF CERVICAL INJURY IN REAL AND SIMULATED ACCIDENTS [RISQUE DE LESIONS CERVICALES EN ACCIDENTS REELS ET SIMULES]
C. Tarriere, J. Y. Foret-Bruno, J. Y. LeCoz, C. Got, and F. Guillon (Hopital Raymond Poincare, Garches, France) *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 17 p In FRENCH (For primary document see N90-25459 19-52)
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The Lab of Physiology and Biomechanics in association with PSA and Renault made use of two sources of data which adds to the understanding of risk and mechanics associated with vertebral injury. The data is from real multidisciplinary tests of 6589 vehicle occupants involved in accidents with body injuries and 9789 injuries involving the front seat of a vehicle and from 375 experimental tests with cadavers (simulated frontal and lateral, free fall, collision tests, etc.). The first part is essentially about the risk of vertebral injury with or without direct impact on the head with only seat belt simulated in different types of real accidents. The second part concerns the tests with cadavers which gives a better understanding of the mechanics of vertebral injury, thanks to the measurement of different physical parameters (maximum angle of head-chest, speed and angular acceleration, etc.).
Transl. by E.R.

N90-25476# Waterloo Univ. (Ontario). Dept. of Kinesiology.
A COMPUTER SIMULATION MODEL FOR STUDYING CERVICAL SPINE INJURY PREVENTION
P. J. Bishop and R. P. Wells *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 5 p (For primary document see N90-25459 19-52)
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Cervical spine fractures, particularly of the burst type due to axial compressive loading of the spine, are a problem in sports and transportation. Such injuries are usually associated with a head first collision, in which the head strikes a rigid surface (e.g., windscreen, dashboard, etc.), with the neck partially to fully flexed. A computer simulation model was developed as one means by which protective devices can be evaluated. The model consists of two rigid masses (head and torso), three spring elements (dashpots and non-linear springs) representing the neck and the compliance of the cranium and scalp, and three optional spring elements taken to represent the characteristics of the protective devices. Simulations using the model, at impact velocities of 1.8 and 3.0 m/sec, suggest that to maintain cervical spine loads at a non-injurious level (e.g., below 20000N) requires a padding material thickness incompatible with wearing a helmet. Author

N90-25477# Institut de Recherche de Transports, Bron (France). Lab. de Chocs et de Biomecanique.
BIOFIDELITY OF A DUMMY'S NECK DURING AUTOMOBILE COLLISION TESTING [BIOFIDELITE DES COUS DE MANNEQUINS AU COURS DES ESSAIS DE CHOCS AUTOMOBILES]
R. Willinger and D. Cesari *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 11 p In FRENCH (For primary document see N90-25459 19-52)
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Dummies are widely used in research on the protection of automobile passengers. The dummies were designed for use in acquiring knowledge of the biomechanics of the human body subjected to collisions. The necks of some of the dummies were designed in such a way as to behave similar to those of humans. Herein, an analysis is proposed based also on a bibliographic survey, of the 3-D kinematics of the heads of dummies (SID, Hybrid 3, and EUROSID) with the object of studying their biofidelity. Generally, the biofidelity is better in frontal as opposed to lateral collisions. This is essentially explained by the fact that the head rotation around its vertical axis is not taken into account in the design of dummies. The biofidelity and performance of dummies rest on the biomechanic conclusions sometimes drawn from cadavers. The validity of these tests is studied along with suggestions for future testing. Transl. by E.R.

N90-25478# Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft (Netherlands). Road-Vehicles Research Inst.
OMNI-DIRECTIONAL HUMAN HEAD-NECK RESPONSE
Abstract Only
J. Wismans *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 1 p Presented at the 1986 STAPP Car Crash Conference (For primary document see N90-25459 19-52)
(SAE-861893) Copyright Avail: NTIS HC A10/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The Naval Biodynamics Laboratory (NBDL) in New Orleans has conducted an extensive research program over the past years to determine the head-neck response of volunteers to impact acceleration. These subjects were exposed to impacts in frontal, lateral, and oblique directions. An analysis of a limited number of frontal and lateral tests from a test series conducted in the late seventies with two subjects showed that the observed head-neck dynamics can be described by means of a relatively simple 2-pivot analog system. This analysis is extended to a more recent NBDL test program with 16 human subjects. The database consists of 119 frontal, 72 lateral, and 62 oblique tests. The research methodology used for this analysis includes a detailed description of three-dimensional kinematics as well as load calculations near T1 and the occipital condyles. A description of this research methodology and a summary of the major test results is presented. Special attention is given to the influence of impact severity and impact direction on the head-neck dynamics. It is shown that a similiar analog system as proposed earlier for frontal and lateral impacts is suitable for all impact directions. Geometrical properties of this analog were determined by means of newly developed numerical techniques rather than through the graphical techniques that were used earlier. Findings of this analysis are discussed in view of future omni-directional mechanical neck developments.
Author

N90-25479# Naval Air Development Center, Warminster, PA.
MEASUREMENT TECHNIQUES, EVALUATION CRITERIA AND INJURY PROBABILITY ASSESSMENT METHODOLOGIES DEVELOPED FOR NAVY EJECTION AND CRASHWORTHY SEAT EVALUATIONS
George D. Frisch, Lawrence E. Kinker, and Paul H. Frisch (Applied Physics, Inc., Nanuet, NY.) *In* AGARD, Neck Injury in Advanced Military Aircraft Environments Feb. 1990 8 p (For primary document see N90-25459 19-52)
Copyright Avail: NTIS HC A10/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Head and neck injuries are of particular concern to Navy researchers and extensive programs were initiated to address head and neck response of both live human subjects and human analogs to crash impact forces. This concern was somewhat heightened by the apparently conflicting operational requirements of having canopy penetration as the principal means of ejection in several aircraft prototypes, coupled to the requirement of introducing night vision capability in attack aircraft. The latter will most probably lead to increased helmet volume, and possibly weight, which increases the probability of helmet canopy acrylic interaction during canopy penetration. Increased helmet weight and center of gravity shifts, together with altered helmet to head coupling, will certainly

change head and neck response to even presumably safe exposure levels. In order to adequately parameterize head and neck response and relate the gathered data to known living human subject and cadaver data, both inertial response and load data must be obtained at well defined, anatomically correctable points. A modified Hybrid 3 type head and neck complex was developed, ballasted to be in compliance with Navy generated head and neck mass distribution parameters, and fully instrumented at the head center of gravity (CG), occipital condyles, and the base of the neck. The fully instrumented head and neck system was utilized to evaluated various helmet configurations and the effect on head and neck response with changes in helmet weight and geometry. Additionally, neck extension, compression, shear forces, and torques were obtained during dynamic ejection tests ranging from 0/0 to 720 KEAS. At the higher speeds, the effects of aerodynamic lift can be identified on the monitored neck compression-tension values. With such data, injury modalitiens and probabilities can be addressed in considerably greater detail than the present norm and the effectiveness of protective equipment established. Author

N90-25480*# National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CUMULATIVE INDEX TO A CONTINUING BIBLIOGRAPHY (SUPPLEMENT 332)
Jan. 1990 178 p
(NASA-SP-7011(332); NAS 1.21:7011(332)) Avail: NTIS HC A11; NTIS standing order as PB89-912300, $18.00 domestic, $36.00 foreign CSCL 06E

This publication is a cumulative index to the abstracts contained in Supplements 320 through 331 of Aerospace Medicine and Biology: A Continuing Bibliography. Seven indexes are included -- subject, personal author, corporate source, foreign technology, contract number, report number and accession number. Author

N90-25481* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 337)
Jun. 1990 123 p
(NASA-SP-7011(337); NAS 1.21:7011(337)) Avail: NTIS HC A06; NTIS standing order as PB90-912300, $11.50 domestic, $23.00 foreign CSCL 06E

This bibliography lists 400 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during May 1990. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N90-25482* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 338)
Jul. 1990 57 p
(NASA-SP-7011(338); NAS 1.21:7011(338)) Avail: NTIS HC A04; NTIS standing order as PB90-912300, $11.50 domestic, $23.00 foreign CSCL 06E

This bibliography lists 139 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during June 1990. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N90-25483# European Space Agency, Paris (France).
STUDIES ON PREDICTING THE RESYNCHRONIZATION OF THE CIRCADIAN SYSTEM AFTER TRANSMERIDIAN FLIGHTS
Michael Ripkens (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) May 1990 120 p Transl. into ENGLISH from Untersuchung zur Vorhersage der Resynchronisation des zirkadianen Systems nach transmeridianen Fluegen (Cologne, Fed. Republic of Germany, DFVLR), Feb. 1989 122 p Original language document was announced as N90-12172
(ESA-TT-1177; DFVLR-FB-89-10; ETN-90-97079) Avail: NTIS HC A06/MF A01

Three flight experiments with 8 subjects each were carried out to study resynchronization in the circadian rhythms of different body functions after timeshifts of 6 and 9 hours. This was to examine whether the speed of adaptation could be predicted from the individual rhythm parameters of preflight control days. Significant correlations were found only in a few cases for some functions. Since, in addition, the reproductibility was too low, the hypothesis that it will be possible to predict the individual adaptation rate had to be rejected. This statement should not be generalized, as the number of subjects was too small and the procedure employed did not permit more general conclusions. ESA

N90-25484# European Space Agency, Paris (France).
BIOCHEMICAL AND PHYSIOLOGICAL CHANGES IN GLIDER PILOTS DURING MULTI-HOUR FLIGHTS
Klaus Gerecht (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) May 1990 106 p Transl. into ENGLISH from Biochemische und physiologische Veraenderungen bei Piloten von Segelflugzeugen waehrend laengerer Fluege (Cologne, Fed. Republic of Germany, DLR), Jun. 1989 118 p Original language document was announced as N90-13018
(ESA-TT-1183; DLR-FB-89-29; ETN-90-97082) Avail: NTIS HC A06/MF A01

Nine male glider pilots aged 21 to 43 years with above-average flight experience were investigated during 13 multi-hour glider flights. Blood and urine samples were taken before, during and after each flight. The results revealed a high sympathetic adrenomedullary and adrenocortical activity. Findings included a reduction in numbers of eosinophils, changes in blood lipid fractions due to induced lipolysis and an elevation of blood sugar concentrations during the flight going back to normal shortly after landing. Excretion of epinephrine was highest during the preflight period showing a high level of anticipatory stress, followed by moderate reductions during the flight as opposed to increasing excretion rates of norepinephrine and 17-hydroxycorticosteroids. This pattern possibly relates to a rise in fatigue with length of flight. Dehydration occurred in a spite of fluid-intake with high urinary output caused by pressure diuresis and kidney dysregulation induced by the Gauer-Henry-Refex by hyperventilation and half-supine position of the pilot in the glider plus undetermined losses via the skin and lungs. Subsequently loss of weight and elevated haematocrit were noted. Reduced serum potassium concentrations associated with more alkaline urine represent sequelae of hyperventilation, which is commonly found in pilots under flight stress. ESA

N90-25485# European Space Agency, Paris (France).
EFFECTS OF A TIME ZONE SHIFT OF 9 HOURS ON THE CIRCADIAN RHYTHMS IN COCKPIT AIRCREW MEMBERS ON LONGHAUL FLIGHTS
Silke Ruth Hasenclever (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) May 1990 83 p Trans. into ENGLISH from Auswirkungen einer Zeitzonenverschiebung von 9 Stunden auf die zirkadiane Rhythmik von Cockpitbesatzungen bei Langstreckenfluegen (Cologne, Fed. Republic of Germany, DLR), Jun. 1989 94 p Original language document was announced as N90-13019
(ESA-TT-1185; DLR-FB-89-31; ETN-90-97084) Avail: NTIS HC A05/MF A01

For 12 aircrew members on a flight schedule which crossed nine time zones, data for heart rate, temperature and the excretion of certain hormone metabolites and electrolytes in urine were continuously collected over a 7-day period, then analyzed for circadian rhythms. The results of rhythm analysis of these parameters are set out and the significance of such disruptions in body rhythm for this occupational group is illustrated. ESA

N90-25542*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
USEFULNESS OF HEART MEASURES IN FLIGHT SIMULATION
Randall L. Harris, Sr., Gregory A. Bonadies, and J. Raymond Comstock, Jr. *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 353-359 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 06P

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N90-25486# Human Engineering Labs., Aberdeen Proving Ground, MD.
THE ROLE OF ATTENTION IN INFORMATION PROCESSING IMPLICATIONS FOR THE DESIGN OF DISPLAYS Final Report
Lynn C. Oatman Dec. 1989 44 p
(DA Proj. 1L1-61102-B-74-A)
(AD-A219252; HEL-TN-14-89) Avail: NTIS HC A03/MF A01 CSCL 05/2

A principal goal in human factors engineering (HFE) is to develop a theoretical and empirical basis for matching the attentional mechanisms of the human operator with the appropriate information portrayed by the visual display. Since a display serves as an interface between the human operator and a dynamic system, its structure and composition are critical to the operator's performance. A display compatible with the human operator's attention mechanisms will improve performance by allowing faster, more accurate information processing, and will minimize mental work load. The system designer has to predict which attention mechanism an operator will use in a specific task situation. A very effective human-system interface will result if the designer succeeds in matching the displayed information with the appropriate attention mechanism. GRA

N90-25487# Eagle Technology, Inc., Winter Park, FL.
DEVELOPMENT OF A META-ANALYTIC TECHNIQUE TO ASSESS STRESS EFFECTS Final Technical Report, Sep. 1988 - Apr. 1989
James E. Driskell, Brian Mullen, and Cheryl L. Batchelor (Air Force Human Resources Lab., Wright-Patterson AFB, OH.) Mar. 1990 54 p Submitted for publication
(Contract F33615-88-C-0017; AF Proj. 1710)
(AD-A220468; AFHRL-TP-89-19) Avail: NTIS HC A04/MF A01 CSCL 05/8

The true test of military systems and personnel is their ability to operate efficiently in the high stress combat environment. This is especially true in the field of combat maintenance, because the maintenance function is essential to maintaining the high rate of sorties required on the future battlefield. Yet maintenance personnel, although highly trained and skilled technicians, receive little preparation for the extreme stresses of the combat environment. The present effort takes a unique and innovative approach, utilizing a meta-analytic technique, to identify the stress factors that restrict or limit effective performance. Preliminary analyses examining the effects of time pressure, group pressure, and noise on performance indicate that this approach is technically sound and of significant practical value. GRA

N90-25488# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany, F.R.). Abt. Luft- und Raumfahrtpsychologie.
THE PREDICTION OF PROFESSIONAL SUCCESS OF LICENCED PILOTS: THE VALIDITY OF FLIGHT EXPERIENCE IN COMPARISON WITH STANDARDIZED PSYCHOLOGICAL APTITUDE TESTS
Peter Maschke and Hans-Juergen Hoermann Aug. 1989 41 p In GERMAN; ENGLISH summary
(DLR-FB-89-53; ISSN-0171-1342; ETN-90-96457) Avail: NTIS HC A03/MF A01; DLR, VB-PL-DO, Postfach 40 60 58, 5000 Cologne, Fed. Republic of Germany, 15.50 DM

The predictive validities of a psychological aptitude test battery were determined in comparison with variables of flight experience. Rating obtained on a three level scale after the first line check served as the criterion. Univariate and multivariate statistical analyses revealed acceptable predictive validity for the psychological aptitude tests. In contrast, variables of flight experience did not contribute significantly to the prognosis of professional success. ESA

N90-25489# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany, F.R.). Abt. Luft- und Raumfahrtpsychologie.
STUDY OF THE APPLICATION OF A STRESS REACTIVITY TEST IN PERSONNEL SELECTION Ph.D. Thesis - Wuerzburg Univ.
Manfred Barbarino Jun. 1989 81 p In GERMAN; ENGLISH summary
(DLR-FB-89-54; ISSN-0171-1342; ETN-90-96458) Avail: NTIS HC A05/MF A01; DLR, VB-PL-DO, Postfach 40 60 58, 5000 Cologne, Fed. Republic of Germany, 27.50 DM

The application of reaction ability tests for personnel selection, designed to measure certain dimensions of personality, is discussed on the basis of an empirical study. The Tower of Hanoi was chosen as a reaction ability test in the context of German military pilot selection. The criteria for measuring reactions to stress include parameters of self-described feelings, coping strategies and psychological measures. Some parameters show the expected differences between control and experimental situation. Some selected reaction ability parameters prove to be sufficiently reliable and to correlate with other methods of the test battery. ESA

N90-25490# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany, F.R.). Abt. Luft- und Raumfahrtpsychologie.
TOM: TEST OF MULTIPLE TASK PERFORMANCE, USER MANUAL
Hans-Juergen Hoermann, Dietrich Manzey, and Georg H. Finell Oct. 1989 48 p
(DLR-FB-89-60; ISSN-0171-1342; ETN-90-97010) Avail: NTIS HC A03/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 18.50 deutsche marks

The capability to cope with several tasks at the same time as one of the most important aptitude characteristics of pilots is addressed. In order to assess this basic capability, a computerized test of multiple task performance (TOM) was developed. This test consists of four independent tasks which are given to the subject on a monitor and which have to be performed simultaneously: two tracking tasks, one choice-reaction time task, and one mental arithmetic task. Details of test application (including standardized texts for an instruction of subjects to be tested), test evaluation, and some guidelines for an interpretation of the test results are described in detail. First empirical results which prove the reliability and the predictive validity of the test for the selection of (student) pilots are presented. ESA

N90-25491# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hamburg (Germany, F.R.). Abt. Luft- und Raumfahrtpsychologie.
INTERNATIONAL APPLICATION OF THE DLR TEST-SYSTEM: FIRST YEAR OF COOPERATION WITH IBERIA IN PILOT SELECTION
Dietrich Manzey, Hans-Juergen Hoermann, Gabriele Osnabruegge, and Klaus-Martin Goeters Jan. 1990 66 p
(DLR-FB-90-05; ISSN-0171-1342; ETN-90-97014) Avail: NTIS HC A04/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 24 deutsche marks

During the first year of cooperation between DLR (Department of Aviation and Space Psychology) and the Spanish flag carrier Iberia, a parallel version of the German DLR test-system for the selection of student pilots was developed and applied in Spain.

The results of the first selection campaigns and the statistical evaluation of the tests are reported. Comparisons between different groups of applicants (German and Spanish applicants, male and female Spanish applicants) are made. ESA

N90-25492 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Vision Group.
ON THE RELATION BETWEEN VARIOUS LEVELS OF TARGET ACQUISITION Final Report
J. J. Ivos Oct. 1989 16 p Sponsored by Royal Netherlands Army
(Contract A85/D/110)
(IZF-1989-38; TD-89-4139; ETN-90-96997) Copyright Avail: TNO Institute for Perception, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

Laboratory target acquisition data were reanalyzed in order to determine the relation between different levels of target acquisition, such as detection, recognition and identification. It turns out that these levels essentially differ by a contrast difference in Z-probability score. Though the magnitude of the difference may differ, depending on the set of targets, an operational definition is proposed by Z(sub recognition) equal to Z(sub detection) - 0.5 and Z(sub identification) equal to Z(sub detection) - 1. This finding is very much at variance with the ACQUIR model of target acquisition. As a consequence detection, recognition and identification ranges are predicted to be far less different than predicted by ACQUIR. ESA

N90-25493 Institute for Perception RVO-TNO, Soesterberg (Netherlands).
PHIND, AN ANALYTICAL MODEL TO PREDICT TARGET ACQUISITION DISTANCE WITH IMAGE INTENSIFIERS Final Report
J. J. Vos and A. vanMeeteren 23 Oct. 1989 29 p Sponsored by Royal Netherlands Army
(Contract A85/D/110)
(IZF-1989-45; TD-89-4144; ETN-90-96998) Copyright Avail: TNO Institute for Perception, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

A calculation scheme to predict the visual range with image intensifiers is further elaborated and quantified. As a result a simple calculation program, PHIND, is produced in FORTRAN, or to be run on a hand calculator. In this program the physical characteristics of the image intensifier and the observation conditions (target size and contrast and the meteorological visual range) have to be introduced. It then calculates the recognition distance for any value of the vertical illuminance. The program was tested against a sizeable experimental data set. The recognition distance for widely varying targets could be described on the basis of realistic physical target contrasts with respect to background, and a characteristic size which may be related to typical background clutter. ESA

N90-25494# European Space Agency, Paris (France).
DIFFERENTIAL PSYCHOLOGICAL ANALYSIS OF A COMPUTER-BASED AUDIO-VISUAL TEST OF VIGILANCE
Peter Maschke and Georg H. Finell (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hamburg, Germany, F.R.) May 1990 50 p Transl. into ENGLISH from Differentiellpsychologiche Analyse eines Computergesteuerten Audio-visuellen Vigilanztests (Hamburg, Fed. Republic of Germany, DFVLR), May 1988 48 p Original language document was announced as N89-13140
(ESA-TT-1136; DFVLR-FB-88-23; ETN-90-97073) Avail: NTIS HC A03/MF A01

An audio-visual vigilance test in which visual signals (pointer deflections) and auditory (letter) signals are presented simultaneously is investigated with regard to its differential and diagnosic value. The test subject pool consisted of 261 applicants for work as airline pilots and 241 applicants for work as air traffic controllers. Correlational and factorial analyses with reference tests indicate the existence of two independent vigilance constructs: signal detection and false alarms. For both test subject pools, these characteristics are adequately reliable, both visually and auditorily. ESA

N90-25539*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
PERFORMANCE-BASED WORKLOAD ASSESSMENT: ALLOCATION STRATEGY AND ADDED TASK SENSITIVITY
Michael A. Vidulich *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 329-335 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05I

N90-25540*# Illinois Univ., Urbana-Champaign. Dept. of Psychology.
REAL-TIME MEASUREMENT OF MENTAL WORKLOAD: A FEASIBILITY STUDY
Arthur Kramer, Darryl Humphrey, Erik Sirevaag, and Axel Mecklinger *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 339-345 (For primary document see N90-25503 19-59)
(Contract NAG2-308; N00014-89-J-1493)
Avail: NTIS HC A99/MF A04 CSCL 05I

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N90-25495*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
MAN-MACHINE INTERFACE FOR THE CONTROL OF A LUNAR TRANSPORT MACHINE
Richard Ashley, Loring Bacon, Scott Tim Carlton, Mark May, Jimmy Moore, and Dennis Peek 25 Aug. 1987 95 p
(Grant NGT-21-002-800)
(NASA-CR-184935; NAS 1.26:184935; ME-4182) Avail: NTIS HC A05/MF A01 CSCL 05H

A proposed first generation human interface control panel is described which will be used to control SKITTER, a three-legged lunar walking machine. Under development at Georgia Tech, SKITTER will be a multi-purpose, un-manned vehicle capable of preparing a site for the proposed lunar base in advance of the arrival of men. This walking machine will be able to accept modular special purpose tools, such as a crane, a core sampling drill, and a digging device, among others. The project was concerned with the design of a human interface which could be used, from earth, to control the movements of SKITTER on the lunar surface. Preliminary inquiries were also made into necessary modifications required to adapt the panel to both a shirt-sleeve lunar environment and to a mobile unit which could be used by a man in a space suit at a lunar work site. Author

N90-25496*# Texas Univ., Austin. Dept. of Mechanical Engineering.
DESIGN OF A DEVICE TO REMOVE LUNAR DUST FROM SPACE SUITS FOR THE PROPOSED LUNAR BASE
David Harrington, Jack Havens, and Daniel Hester 1990 117 p
(Contract NASw-4435)
(NASA-CR-186679; NAS 1.26:186679) Avail: NTIS HC A06/MF A01 CSCL 06K

The National Aeronautics and Space Administration plans to begin construction of a lunar base soon after the turn of the century. During the Apollo missions, lunar dust proved to be a problem because the dust adhered to all exposed material surfaces. Since lunar dust will be a problem during the establishment and operation of this base, the need exists for a device to remove the

dust from space suits before the astronauts enter clean environments. The physical properties of lunar dust were characterized and energy methods for removing the dust were identified. Eight alternate designs were developed to remove the dust. The final design uses a brush and gas jet to remove the dust. The brush bristles are made from Kevlar fibers and the gas jet uses pressurized carbon dioxide from a portable tank. A throttling valve allows variable gas flow. Also, the tank is insulated with Kapton and electrically heated to prevent condensation of the carbon dioxide when the tank is exposed to the cold (- 240 F) lunar night. Author

N90-25497*# Florida Technological Univ., Orlando. Dept. of Aerospace Engineering.

DESIGN AND IMPLEMENTATION OF SENSOR SYSTEMS FOR CONTROL OF A CLOSED-LOOP LIFE SUPPORT SYSTEM

Leslie Alnwick, Amy Clark, Patricia Debs, Chris Franczek, Tom Good, and Pedro Rodrigues Dec. 1989 121 p
(Contract NASw-4435)
(NASA-CR-186675; NAS 1.26:186675) Avail: NTIS HC A06/MF A01 CSCL 06K

The sensing and controlling needs for a Closed-Loop Life Support System (CLLSS) were investigated. The sensing needs were identified in five particular areas and the requirements were defined for workable sensors. The specific areas of interest were atmosphere and temperature, nutrient delivery, plant health, plant propagation and support, and solids processing. The investigation of atmosphere and temperature control focused on the temperature distribution within the growth chamber as well as the possibility for sensing other parameters such as gas concentration, pressure, and humidity. The sensing needs were studied for monitoring the solution level in a porous membrane material along with the requirements for measuring the mass flow rate in the delivery system. The causes and symptoms of plant disease were examined and the various techniques for sensing these health indicators were explored. The study of sensing needs for plant propagation and support focused on monitoring seed viability and measuring seed moisture content as well as defining the requirements for drying and storing the seeds. The areas of harvesting, food processing, and resource recycling, were covered with a main focus on the sensing possibilities for regulating the recycling process. Author

N90-25498* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HAZARDS PROTECTION FOR SPACE SUITS AND SPACECRAFT Patent

Joseph J. Kosmo, inventor (to NASA) and Frederic S. Dawn, inventor (to NASA) 8 May 1990 9 p Filed 30 Jun. 1988
Supersedes N89-12206 (27 - 3, p 367)
(NASA-Case-MSC-21366-1; US-Patent-4,923,741; US-Patent-Appl-SN-213880; US-Patent-Class-428-252; US-Patent-Class-428-290; US-Patent-Class-428-328; US-Patent-Class-428-422; US-Patent-Class-428-447; US-Patent-Class-428-458; US-Patent-Class-428-474.4) Avail: US Patent and Trademark Office CSCL 06K

A flexible multi-layered covering article for protection against the hazards of exposure to the environment of outer space is disclosed. The covering includes an outer layer section comprising an outermost lamina of woven expanded tetrafluoroethylene yarns (Gore Tex) for protecting against abrasion and tearing, an underlying weave of meta-aramid yarns (Nomex) and para-aramid yarns (Kevlar) for particle impart protection, and electrostatic charge dissipation and control system incorporated therein, and a chemical contaminants control barrier applied as a coating. A middle section includes a succession of thermal insulating layers of polymeric thermoplastic or thermoforming material, each of which is coated with a metal deposit of high infra-red emissivity and low solar radiation absorption characteristics and separated from adjacent insulating layers by a low thermal conductance material. The covering further includes a radiation attenuating layer of a tungsten-loaded polymeric elastomer binder for protecting against bremsstrahlung radiation and an inner layer of rip-stop polyester material for abrasion protection. A chloroprene coating may be supplied the polyester-material for added micrometeroid protection. Securing means of low heat conductance material secures the multi-layers together as a laminar composite.
Official Gazette of the U.S. Patent and Trademark Office

N90-25499*# Carnegie-Mellon Univ., Pittsburgh, PA. Robotics Inst.

A GLOBAL APPROACH FOR USING KINEMATIC REDUNDANCY TO MINIMIZE BASE REACTIONS OF MANIPULATORS

C. L. Chung and S. Desa Mar. 1989 32 p
(Grant NAG3-811)
(NASA-CR-186825; NAS 1.26:186825; CMU-RI-TR-89-9)
Copyright Avail: NTIS HC A03/MF A01 CSCL 05H

An important consideration in the use of manipulators in microgravity environments is the minimization of the base reactions, i.e. the magnitude of the force and the moment exerted by the manipulator on its base as it performs its tasks. One approach which was proposed and implemented is to use the redundant degree of freedom in a kinematically redundant manipulator to plan manipulator trajectories to minimize base reactions. A global approach was developed for minimizing the magnitude of the base reactions for kinematically redundant manipulators which integrates the Partitioned Jacobian method of redundancy resolution, a 4-3-4 joint-trajectory representation and the minimization of a cost function which is the time-integral of the magnitude of the base reactions. The global approach was also compared with a local approach developed earlier for the case of point-to-point motion of a three degree-of-freedom planar manipulator with one redundant degree-of-freedom. The results show that the global approach is more effective in reducing and smoothing the base force while the local approach is superior in reducing the base moment.
Author

N90-25500*# Alabama A & M Univ., Normal. Dept. of Plant and Soil Sciences.

A PROPOSAL TO DEMONSTRATE PRODUCTION OF SALAD CROPS IN THE SPACE STATION MOCKUP FACILITY WITH PARTICULAR ATTENTION TO SPACE, ENERGY, AND LABOR CONSTRAINTS Annual Progress Report, 1 Jul. - 30 Jun. 1990

Carolyn A. Brooks, Govind C. Sharma, and Caula A. Beyl 25 Jul. 1990 30 p
(Contract NCC2-607)
(NASA-CR-186811; NAS 1.26:186811) Avail: NTIS HC A03/MF A01 CSCL 06K

A desire for fresh vegetables for consumption during long term space missions has been foreseen. To meet this need in a microgravity environment within the limited space and energy available on Space Station requires highly productive vegetable cultivars of short stature to optimize vegetable production per volume available. Special water and nutrient delivery systems must also be utilized. As a first step towards fresh vegetable production in the microgravity of Space Station, several soil-less capillary action media were evaluated for the ability to support growth of two root crops (radish and carrot) which are under consideration for inclusion in a semi-automated system for production of salad vegetables in a microgravity environment (Salad Machine). In addition, productivity of different cultivars of radish was evaluated as well as the effect of planting density and cultivar on carrot production and size. Red Prince radish was more productive than Cherry Belle and grew best on Jiffy Mix Plus. During greenhouse studies, vermiculite and rock wool supported radish growth to a lesser degree than Jiffy Mix Plus but more than Cellular Rooting Sponge. Comparison of three carrot cultivars (Planet, Short n Sweet, and Goldinhart) and three planting densities revealed that Short n Sweet planted at 25.6 sq cm/plant had the greatest root fresh weight per pot, the shortest mean top length, and intermediate values of root length and top fresh weight per pot. Red Prince radish and Short n Sweet carrot showed potential as productive cultivars for use in a Salad Machine. Results of experiments with solid capillary action media were disappointing. Further research

must be done to identify a solid style capillary action media which can productively support growth of root crops such as carrot and radish. Author

N90-25501# Pennsylvania Univ., Philadelphia. Dept. of Computer and Information Science.
ACTIVE PERCEPTION AND EXPLORATORY ROBOTICS
Ruzena Bajcsy Oct. 1989 19 p Sponsored by DEC Corp., IBM Corp., and LORD Corp.
(Contracts BOA-104230-87-H-0001; N00014-85-K-0807; NSF DCR-84-10771; F49620-85-K-0018; DAAG29-84-K-0061)
(MS-CIS-89-65; UP-Grasp-Lab-191) Avail: NTIS HC A03/MF A01

Active perception is defined as a problem of an intelligent data acquisition process. For this, one needs to define and measure parameters and errors from the scene which in turn can be fed back to control the data acquisition process. This is a difficult though important problem. The difficulty is that many of the feedback parameters are context-and scene-dependent. The precise definition of these parameters depends on a thorough understanding of the data acquisition devices (camera parameters, illumination and reflectance parameters), algorithms (edge detectors, region growers, 3-D recovery procedures) as well as the goal of the visual processing. The importance, however, of this understanding is that one does not spend time on processing and artificially improving imperfect data but rather on accepting imperfect, noisy data as a matter of fact and incorporating it into the overall processing strategy. The second point is that manipulation is an essential part of perceptual process. The hand is as the eye: a sensory device. Subsequently, one needs to consider not only signal processing modules but also basic manipulatory action called exploratory procedures as an essential ingredient of perceptual theory. The third and last point made is a case for exploratory robotics. It is assumed that the size and shape of the object is sufficient for grasping purposes. It should be very apparent that unless one knows what materials are being used the system may be easily fooled. And even if the material of the outer surface is known the inside is not, which may very dramatically change the weight, and hence, the grasping strategy. The research aims to fill this gap. The question of rigidity is also very crucial when a grasping strategy is considered. Furthermore, the tests for hinges and bending are the first tests towards testing the functionality of an object. In the test for rigidity, what changes occur when other controlled manipulatory actions are applied on such objects, for example, lifting or rotating the object in space is explored. All these steps are part of a general examination of the object, finding stable positions, etc. All these tests lead to understanding of what the necessary components are for a general purpose Perceptual Theory. Author

N90-25514*# Air Force Systems Command, Wright-Patterson AFB, OH.
SDIO ROBOTICS IN SPACE APPLICATIONS
Richard Iliff *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 133-136 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25518*# Lockheed Engineering and Sciences Co., Houston, TX.
QUANTITATIVE ASSESSMENT OF HUMAN MOTION USING VIDEO MOTION ANALYSIS
John D. Probe *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 155-157 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25522*# Stanford Univ., CA. Knowledge Systems Lab.
AN EXPERT SYSTEM TO ADVISE ASTRONAUTS DURING EXPERIMENTS: THE PROTOCOL MANAGER MODULE
Guido Haymann-Haber, Silvano P. Colombano, Nicolas Groleau, Don Rosenthal, Peter Szolovits, and Laurence R. Young (Massachusetts Inst. of Tech., Cambridge.) *In* NASA, Lyndon B. Johnson Space Center, Third Annaul Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 187-194 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25523*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM ADVANCED AUTOMATION PROJECT. PHASE 1: APPLICATION EVALUATION
Brandon S. Dewberry *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 195-208 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 06K

N90-25526*# Lockheed Engineering and Sciences Co., Houston, TX.
TELEPRESENCE FOR SPACE: THE STATE OF THE CONCEPT
Randy L. Smith, Douglas J. Gillan, and Mark A. Stuart *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 223-228 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25527*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TELEPRESENCE AND SPACE STATION FREEDOM WORKSTATION OPERATIONS
Dean G. Jensen, Susan C. Adam, James H. Stramler, and Robert P. Wilmington (Lockheed Engineering and Sciences Co., Houston, TX.) *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 229-234 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25528*# Bureau of Mines, Minneapolis, MN. Human Factors Group.
THE HUMAN FACTORS OF WORKSTATION TELEPRESENCE
Thomas J. Smith and Karl U. Smith (Wisconsin Univ., Madison.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 235-250 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25537*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE FLIGHT TELEROBOTIC SERVICER (FTS) NASA'S FIRST OPERATIONAL ROBOTIC SYSTEM
J. Andary, K. Halterman, D. Hewitt, and P. Sabelhaus *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 311-318 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25538*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE TELEROBOT TESTBED: AN ARCHITECTURE FOR REMOTE SERVICING
J. R. Matijevic *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 321-328 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25555*# California Univ., Berkeley. Telerobotics Unit.
A HELMET MOUNTED DISPLAY TO ADAPT THE TELEROBOTIC ENVIRONMENT TO HUMAN VISION
Gregory Tharp, Andrew Liu, Hitomi Yamashita, and Lawrence

Stark *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 477-481 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25556*# Carlow Associates, Inc., Fairfax, VA.
HUMAN FACTORS ISSUES IN TELEROBOTIC SYSTEMS FOR SPACE STATION FREEDOM SERVICING
Thomas B. Malone and Kathryn E. Permenter *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 485-492 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

N90-25565*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JPL TELEROBOT OPERATOR CONTROL STATION: OPERATIONAL EXPERIENCES
Edwin P. Kan *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 567-575 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N90-25502*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ICASE SEMIANNUAL REPORT, APRIL 1 - SEPTEMBER 30, 1989 Final Report
Feb. 1990 67 p
(Contract NAS1-18605)
(NASA-CR-181988; NAS 1.26:181988) Avail: NTIS HC A04/MF A01 CSCL 12A

The Institute conducts unclassified basic research in applied mathematics, numerical analysis, and computer science in order to extend and improve problem-solving capabilities in science and engineering, particularly in aeronautics and space. The major categories of the current Institute for Computer Applications in Science and Engineering (ICASE) research program are: (1) numerical methods, with particular emphasis on the development and analysis of basic numerical algorithms; (2) control and parameter identification problems, with emphasis on effective numerical methods; (3) computational problems in engineering and the physical sciences, particularly fluid dynamics, acoustics, and structural analysis; and (4) computer systems and software, especially vector and parallel computers. ICASE reports are considered to be primarily preprints of manuscripts that have been submitted to appropriate research journals or that are to appear in conference proceedings. Author

N90-25503*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THIRD ANNUAL WORKSHOP ON SPACE OPERATIONS AUTOMATION AND ROBOTICS (SOAR 1989)
Sandy Griffin, ed. Washington Mar. 1990 651 p Workshop held in Houston, TX, 25-27 Jul. 1989; sponsored by NASA, Washington, the AF, and Houston-Clear Lake Univ.
(NASA-CP-3059; S-599; NAS 1.55:3059) Avail: NTIS HC A99/MF A04 CSCL 12A

Papers presented at the Third Annual Workshop on Space Operations Automation and Robotics (SOAR '89), hosted by the NASA Lyndon B. Johnson Space Center at Houston, Texas, on July 25 to 27, 1989, are given. Approximately 100 technical papers were presented by experts from NASA, the USAF, universities, and technical companies. Also held were panel discussions on Air Force/NASA Artificial Intelligence Overview and Expert System Verification and Validation. For individual titles, see N90-25504 through N90-25577.

N90-25504*# Air Force Systems Command, Andrews AFB, MD. Artificial Intelligence Technology Development.
ARTIFICIAL INTELLIGENCE WITHIN AFSC **c63**
Mark A. Gersh *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 13-46 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

Information on artificial intelligence research in the Air Force Systems Command is given in viewgraph form. Specific research that is being conducted at the Rome Air Development Center, the Space Technology Center, the Human Resources Laboratory, the Armstrong Aerospace Medical Research Laboratory, the Armamant Laboratory, and the Wright Research and Development Center is noted. Author

N90-25505*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MOBILE TRANSPORTER PATH PLANNING **c61**
Paul Baffes and Lui Wang *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 51-59 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

The use of a genetic algorithm (GA) for solving the mobile transporter path planning problem is investigated. The mobile transporter is a traveling robotic vehicle proposed for the space station which must be able to reach any point of the structure autonomously. Elements of the genetic algorithm are explored in both a theoretical and experimental sense. Specifically, double crossover, greedy crossover, and tournament selection techniques are examined. Additionally, the use of local optimization techniques working in concert with the GA are also explored. Recent developments in genetic algorithm theory are shown to be particularly effective in a path planning problem domain, though problem areas can be cited which require more research. Author

N90-25506*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SOAR 89: SPACE STATION. SPACE SUIT TEST PROGRAM **c18**
Joseph J. Kosmo, Philip West, and Michael Rouen *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 61-90 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

The elements of the test program for the space suit to be used on Space Station Freedom are noted in viewgraph form. Information is given on evaluation objectives, zero gravity evaluation, mobility evaluation, extravehicular activity task evaluation, and shoulder joint evaluation. Author

N90-25507*# Air Force Systems Command, Hanscom AFB, MA.
SPACECRAFT CONTAMINATION PROGRAMS WITHIN THE AIR FORCE SYSTEMS COMMAND LABORATORIES **c18**
Edmond Murad *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 97-98 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

Spacecraft contamination programs exist in five independent AFSC organizations: Geophysics Laboratory (GL), Arnold Engineering and Development Center (AEDC), Rome Air Development Center (RADC/OSCE), Wright Research and Development Center (MLBT), Armament Laboratory (ATL/SAI), and Space Systems Division (SSD/OL-AW). In addition, a sizable program exists at Aerospace Corp. These programs are complementary, each effort addressing a specific area of expertise: GL's effort is aimed at addressing the effects of on-orbit contamination; AEDC's effort is aimed at ground simulation and measurement of optical contamination; RADC's effort addresses the accumulation, measurement, and removal of contamination on large optics; MLBT's effort is aimed at understanding the effect of contamination on materials; ATL's effort is aimed at understanding the effect of plume contamination on systems; SSD's effort is confined to the integration of some contamination experiments sponsored by SSD/CLT; and Aerospace Corp.'s effort is aimed at supporting the needs of the using System Program Offices (SPO) in specific areas, such as contamination during ground handling, ascent phase, laboratory measurements aimed at understanding on-orbit contamination, and mass loss and mass gain in on-orbit operations. These programs are described in some detail, with emphasis on GL's program. Author

N90-25508*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
CONTAMINATION OF SPACECRAFT BY RECONTACT OF DUMPED LIQUIDS **c18**
M. E. Fowler, L. J. Leger, M. E. Donahoo, and P. D. Maley (Rockwell Shuttle Operations Co., Houston, TX.) *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 99-104 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

Liquids partially freeze when dumped from spacecraft producing particles which are released into free space at various velocities. Recontact of these particles with the spacecraft is possible for specific particle sizes and velocities and, therefore, can become contamination for experiments within the spacecraft or released experiments as a result of waste and potable water dumped from Space Shuttle. An examination of dump characteristics was conducted on STS-29 using both on-board video records and ground based measurements. A preliminary analysis of data from this flight indicates particle velocities are in the range of 30 to 75 ft/sec and recontact is possible for limited particle sizes. Author

N90-25509*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTOMATION IN THE SPACE STATION MODULE POWER MANAGEMENT AND DISTRIBUTION BREADBOARD **c20**
Bryan Walls and Louis F. Lollar *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 107-111 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10B

The Space Station Module Power Management and Distribution (SSM/PMAD) Breadboard, located at NASA's Marshall Space Flight Center (MSFC) in Huntsville, Alabama, models the power distribution within a Space Station Freedom Habitation or Laboratory module. Originally designed for 20 kHz ac power, the system is now being converted to high voltage dc power with power levels on a par with those expected for a space station module. In addition to the power distribution hardware, the system includes computer control through a hierarchy of processes. The lowest level process consists of fast, simple (from a computing standpoint) switchgear, capable of quickly safing the system. The next level consists of local load center processors called Lowest Level Processors (LLP's). These LLP's execute load scheduling, perform redundant switching, and shed loads which use more than scheduled power. The level above the LLP's contains a Communication and Algorithmic Controller (CAC) which coordinates communications with the highest level. Finally, at this highest level, three cooperating Artificial Intelligence (AI) systems manage load prioritization, load scheduling, load shedding, and fault recovery and management. The system provides an excellent venue for developing and examining advanced automation techniques. The current system and the plans for its future are examined. Author

N90-25510*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
NASA SYSTEMS AUTONOMY DEMONSTRATION PROJECT: ADVANCED AUTOMATION DEMONSTRATION OF SPACE STATION FREEDOM THERMAL CONTROL SYSTEM **c18**
Jeffrey Dominick, John Bull, and Kathleen J. Healey *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 113-116 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

The NASA Systems Autonomy Demonstration Project (SADP) was initiated in response to Congressional interest in Space station automation technology demonstration. The SADP is a joint cooperative effort between Ames Research Center (ARC) and Johnson Space Center (JSC) to demonstrate advanced automation technology feasibility using the Space Station Freedom Thermal Control System (TCS) test bed. A model-based expert system and its operator interface were developed by knowledge engineers, AI researchers, and human factors researchers at ARC working with the domain experts and system integration engineers at JSC. Its target application is a prototype heat acquisition and transport subsystem of a space station TCS. The demonstration is scheduled to be conducted at JSC in August, 1989. The demonstration will consist of a detailed test of the ability of the Thermal Expert System to conduct real time normal operations (start-up, set point changes, shut-down) and to conduct fault detection, isolation, and recovery (FDIR) on the test article. The FDIR will be conducted by injecting ten component level failures that will manifest themselves as seven different system level faults. Here, the SADP goals, are described as well as the Thermal Control Expert System that has been developed for demonstration. Author

N90-25511*# Ford Aerospace and Communications Corp., Sunnyvale, CA. Artificial Intelligence Group.
STARPLAN: A MODEL-BASED DIAGNOSTIC SYSTEM FOR SPACECRAFT **c61**
Dennis Heher and Paul Pownall *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 117-121 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

The Sunnyvale Division of Ford Aerospace created a model-based reasoning capability for diagnosing faults in space systems. The approach employs reasoning about a model of the domain (as it is designed to operate) to explain differences between expected and actual telemetry; i.e., to identify the root cause of the discrepancy (at an appropriate level of detail) and determine necessary corrective action. A development environment, named Paragon, was implemented to support both model-building and reasoning. The major benefit of the model-based approach is the capability for the intelligent system to handle faults that were not anticipated by a human expert. The feasibility of this approach for diagnosing problems in a spacecraft was demonstrated in a prototype system, named StarPlan. Reasoning modules within StarPlan detect anomalous telemetry, establish goals for returning the telemetry to nominal values, and create a command plan for attaining the goals. Before commands are implemented, their effects are simulated to assure convergence toward the goal. After the commands are issued, the telemetry is monitored to assure that the plan is successful. These features of StarPlan, along with associated concerns, issues and future directions, are discussed. Author

N90-25512*# Rome Air Development Center, Griffiss AFB, NY.
SMART BUILT-IN TEST **c33**
Dale W. Richards *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and

Robotics (SOAR 1989) Mar. 1990 p 123-126 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09C

The work which built-in test (BIT) is asked to perform in today's electronic systems increases with every insertion of new technology or introduction of tighter performance criteria. Yet the basic purpose remains unchanged -- to determine with high confidence the operational capability of that equipment. Achievement of this level of BIT performance requires the management and assimilation of a large amount of data, both realtime and historical. Smart BIT has taken advantage of advanced techniques from the field of artificial intelligence (AI) in order to meet these demands. The Smart BIT approach enhances traditional functional BIT by utilizing AI techniques to incorporate environmental stress data, temporal BIT information and maintenance data, and realtime BIT reports into an integrated test methodology for increased BIT effectiveness and confidence levels. Future research in this area will incorporate onboard fault-logging of BIT output, stress data and Smart BIT decision criteria in support of a singular, integrated and complete test and maintenance capability. The state of this research is described along with a discussion of directions for future development. Author

N90-25513*# Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH.

SOLAR ARRAY AUTOMATION LIMITATIONS **c20**

Terry M. Trumble *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 127-130 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10A

Significant progress in the automation of the spacecraft electrical power systems has been made within the past few years. This is especially important with the development of the space station and the increasing demand on the electrical power systems for future satellites. The key element of the spacecraft power system, the solar arrays which supply the power, will have to grow to supply many tens of kilowatts of power within the next twenty years. This growth will be accompanied by the problems associated with large distributed power systems. The growth of the arrays, the on-array management problems and potential solutions to array degradation or failure are discussed. Multilowatt arrays for unmanned spacecraft with comments on the implications of array degradation for manned spacecraft are discussed. Author

N90-25514*# Air Force Systems Command, Wright-Patterson AFB, OH.

SDIO ROBOTICS IN SPACE APPLICATIONS **c54**

Richard Iliff *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 133-136 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

Robotics in space supporting the Strategic Defense System (SDS) program is discussed. Ongoing initiatives which are intended to establish an initial Robotics in Space capability are addressed. This is specifically being referred to as the Satellite Servicing System (SSS). This system is based on the NASA Orbital Maneuvering Vehicle (OMV) with a Robotic Manipulator(s) based on the NASA Flight Telerobotic Servicer (FTS) and other SSS equipment required to do the satellite servicing work attached to the OMV. Specific Robotics in Space Requirements which have resulted from the completion of the Robotics Requirements Study Contract are addressed. Author

N90-25515*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

CREW CHIEF: A COMPUTER GRAPHICS SIMULATION OF AN AIRCRAFT MAINTENANCE TECHNICIAN **c61**

Nilss M. Aume *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 139-141 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

Approximately 35 percent of the lifetime cost of a military system is spent for maintenance. Excessive repair time is caused by not considering maintenance during design. Problems are usually discovered only after a mock-up has been constructed, when it is too late to make changes. CREW CHIEF will reduce the incidence of such problems by catching design defects in the early design stages. CREW CHIEF is a computer graphic human factors evaluation system interfaced to commercial computer aided design (CAD) systems. It creates a three dimensional man model, either male or female, large or small, with various types of clothing and in several postures. It can perform analyses for physical accessibility, strength capability with tools, visual access, and strength capability for manual materials handling. The designer would produce a drawing on his CAD system and introduce CREW CHIEF in it. CREW CHIEF's analyses would then indicate places where problems could be foreseen and corrected before the design is frozen. Author

N90-25516*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

MODELING STRENGTH DATA FOR CREW CHIEF **c61**

Joe W. McDaniel *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 143-148 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

The Air Force has developed CREW CHIEF, a computer-aided design (CAD) tool for simulating and evaluating aircraft maintenance to determine if the required activities are feasible. CREW CHIEF gives the designer the ability to simulate maintenance activities with respect to reach, accessibility, strength, hand tool operation, and materials handling. While developing the CREW CHIEF, extensive research was performed to describe workers strength capabilities for using hand tools and manual handling of objects. More than 100,000 strength measures were collected and modeled for CREW CHIEF. These measures involved both male and female subjects in the 12 maintenance postures included in CREW CHIEF. The data collection and modeling effort are described. Author

N90-25517*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

THE USE OF PLAID IN THE SPACE STATION FREEDOM VIEWING ANALYSIS **c61**

Frances E. Mount and Sandra D. McKee (Lockheed Engineering and Sciences Co., Houston, TX.) *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 149-153 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

The focus early in the Space Station Freedom Program was on identifying viewing requirements for both direct viewing (windows) and indirect viewing (closed-circuit television). Currently, an analysis is being conducted to address the feasibility of viewing for Space Station Freedom. The goal of this analysis is to determine the optimum location for the windows and closed-circuit television cameras in order to meet the established requirements. Additionally all viewing provisions must adequately support Space Station assembly and on-board operations once the Station is operable. PLAID, a three-dimensional graphics system developed at NASA/Johnson Space Center, was selected for use as the primary tool in this analysis. PLAID provides the capability to simulate the assembly of the Space Station Freedom, as well as to examine operations on the Station as it evolves. In addition, it is used as a tool to analyze general out-the-window viewing conditions for all Space Station components, and provides the ability to integrate an anthropometic scale-modeled person (representing a crew-member) with the Station's interior architecture. Author

N90-25518*# Lockheed Engineering and Sciences Co., Houston, TX.
QUANTITATIVE ASSESSMENT OF HUMAN MOTION USING VIDEO MOTION ANALYSIS **c54**
John D. Probe *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 155-157 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

In the study of the dynamics and kinematics of the human body, a wide variety of technologies was developed. Photogrammetric techniques are well documented and are known to provide reliable positional data from recorded images. Often these techniques are used in conjunction with cinematography and videography for analysis of planar motion, and to a lesser degree three-dimensional motion. Cinematography has been the most widely used medium for movement analysis. Excessive operating costs and the lag time required for film development coupled with recent advances in video technology have allowed video based motion analysis systems to emerge as a cost effective method of collecting and analyzing human movement. The Anthropometric and Biomechanics Lab at Johnson Space Center utilizes the video based Ariel Performance Analysis System to develop data on shirt-sleeved and space-suited human performance in order to plan efficient on orbit intravehicular and extravehicular activities. The system is described. Author

N90-25519*# Photometrics, Inc., Woburn, MA.
GASEOUS OPTICAL CONTAMINATION OF THE SPACECRAFT ENVIRONMENT: A REVIEW **c74**
N. H. Tran, M. A. Maris, I. L. Kofsky, and E. Murad (Air Force Geophysics Lab., Hanscom AFB, MA.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 159-166 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 20F

Interactions between the ambient atmosphere and orbiting spacecraft, sounding rockets, and suborbital vehicles, and with their effluents, give rise to optical (extreme UV to LWIR) foreground radiation which constitutes noise that raises the detection threshold for terrestrial and celestial radiations, as well as military targets. Researchers review the current information on the on-orbit optical contamination. Its source species are created in interaction processes that can be grouped into three categories: (1) Reactions in the gas phase between the ambient atmosphere and desorbates and exhaust; (2) Reactions catalyzed by exposed ram surfaces, which occur spontaneously even in the absence of active material releases from the vehicles; and (3) Erosive excitative reactions with exposed bulk (organic) materials, which have recently been identified in the laboratory though not as yet observed on spacecraft. Researchers also assess the effect of optical pumping by earthshine and sunlight of both reaction products and effluents. Author

N90-25520*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACECRAFT EXTERNAL MOLECULAR CONTAMINATION ANALYSIS **c18**
H. K. F. Ehlers *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 171-178 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

Control of contamination on and around spacecraft is required to avoid adverse effects on the performance of instruments and spacecraft systems. Recent work in this area is reviewed and discussed. Specific issues and limitations to be considered as part of the effort to predict contamination effects using modeling techniques are addressed. Significant results of Space Shuttle missions in the field of molecule/surface interactions as well as their implications for space station design and operation are reviewed. Author

N90-25521*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AUTONOMOUS POWER EXPERT FAULT DIAGNOSTIC SYSTEM FOR SPACE STATION FREEDOM ELECTRICAL POWER SYSTEM TESTBED **c20**
Long V. Truong, Jerry L. Walters, Mary Ellen Roth, Todd M. Quinn, and Walter M. Krawczonek (Sverdrup Technology, Inc., Cleveland, OH.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 181-186 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 21H

The goal of the Autonomous Power System (APS) program is to develop and apply intelligent problem solving and control to the Space Station Freedom Electrical Power System (SSF/EPS) testbed being developed and demonstrated at NASA Lewis Research Center. The objectives of the program are to establish artificial intelligence technology paths, to craft knowledge-based tools with advanced human-operator interfaces for power systems, and to interface and integrate knowledge-based systems with conventional controllers. The Autonomous Power EXpert (APEX) portion of the APS program will integrate a knowledge-based fault diagnostic system and a power resource planner-scheduler. Then APEX will interface on-line with the SSF/EPS testbed and its Power Management Controller (PMC). The key tasks include establishing knowledge bases for system diagnostics, fault detection and isolation analysis, on-line information accessing through PMC, enhanced data management, and multiple-level, object-oriented operator displays. The first prototype of the diagnostic expert system for fault detection and isolation has been developed. The knowledge bases and the rule-based model that were developed for the Power Distribution Control Unit subsystem of the SSF/EPS testbed are described. A corresponding troubleshooting technique is also described. Author

N90-25522*# Stanford Univ., CA. Knowledge Systems Lab.
AN EXPERT SYSTEM TO ADVISE ASTRONAUTS DURING EXPERIMENTS: THE PROTOCOL MANAGER MODULE **c54**
Guido Haymann-Haber, Silvano P. Colombano, Nicolas Groleau, Don Rosenthal, Peter Szolovits, and Laurence R. Young (Massachusetts Inst. of Tech., Cambridge.) *In* NASA, Lyndon B. Johnson Space Center, Third Annaul Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 187-194 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

Perhaps the scarcest resource for manned flight experiments - on Spacelab or on the Space Station Freedom - will continue to be crew time. To maximize the efficiency of the crew and to make use of their abilities to work as scientist collaborators as well as equipment operators, normally requires more training in a wide variety of disciplines than is practical. The successful application of on-board expert systems, as envisioned by the Principal Investigator in a Box program, should alleviate the training bottleneck and provide the astronaut with the guidance and coaching needed to permit him or her to operate an experiment according to the desires and knowledge of the PI, despite changes in conditions. The Protocol Manager module of the system is discussed. The Protocol Manager receives experiment data that has been summarized and categorized by the other modules. The Protocol Manager acts on the data in real-time, by employing expert system techniques. Its recommendations are based on heuristics provided by the Principal Investigator in charge of the experiment. This prototype was developed on a Macintosh II by employing CLIPS, a forward-chaining rule-based system, and HyperCard as an object-oriented user interface builder. Author

N90-25523*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM ADVANCED AUTOMATION PROJECT. PHASE 1: APPLICATION EVALUATION **c54**
Brandon S. Dewberry *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation

and Robotics (SOAR 1989) Mar. 1990 p 195-208 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 06K

The Environmental Control and Life Support System (ECLSS) is a Freedom Station distributed system with inherent applicability to advanced automation primarily due to the comparatively large reaction times of its subsystem processes. This allows longer contemplation times in which to form a more intelligent control strategy and to detect or prevent faults. The objective of the ECLSS Advanced Automation Project is to reduce the flight and ground manpower needed to support the initial and evolutionary ECLS system. The approach is to search out and make apparent those processes in the baseline system which are in need of more automatic control and fault detection strategies, to influence the ECLSS design by suggesting software hooks and hardware scars which will allow easy adaptation to advanced algorithms, and to develop complex software prototypes which fit into the ECLSS software architecture and will be shown in an ECLSS hardware testbed to increase the autonomy of the system. Covered here are the preliminary investigation and evaluation process, aimed at searching the ECLSS for candidate functions for automation and providing a software hooks and hardware scars analysis. This analysis shows changes needed in the baselined system for easy accommodation of knowledge-based or other complex implementations which, when integrated in flight or ground sustaining engineering architectures, will produce a more autonomous and fault tolerant Environmental Control and Life Support System. Author

N90-25524*# Stanford Univ., CA.
MONITORING AND CONTROL OF SPACECRAFT SYSTEMS USING PROCEDURAL REASONING **c63**
Michael P. Georgeff and Francois Felix Ingrand (SRI International Corp., Menlo Park, CA.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 209-217 Sponsored in part by Institut National de Recherche en Informatique et en Automatique (INRIA) (For primary document see N90-25503 19-59)
(Contract NAS2-12521)
Avail: NTIS HC A99/MF A04 CSCL 09B

Research concerned with automating the monitoring and control of spacecraft systems is discussed. In particular, the application of SRI's Procedural Reasoning System (PRS) to the handling of malfunctions in the Reaction Control System (RCS) of NASA's Space Shuttle is examined. Unlike traditional monitoring and control systems, PRS is able to reason about and perform complex tasks in a very flexible and robust manner, somewhat in the manner of a human assistant. Using various RCS malfunctions as examples (including sensor faults, leaking components, multiple alarms, and regulator and jet failures), it is shown how PRS manages to combine both goal-directed reasoning and the ability to react rapidly to unanticipated changes in its environment. In conclusion, some important issues in the design of PRS are reviewed and future enhancements are indicated. Author

N90-25525*# Aerospace Corp., Los Angeles, CA. Computer Science Lab.
KNOWLEDGE REPRESENTATION TO SUPPORT REASONING BASED ON MULTIPLE MODELS **c63**
April Gillam, Jorge P. Seidel, and Alice C. Parker (University of Southern California, Los Angeles.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 219-221 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

Model Based Reasoning is a powerful tool used to design and analyze systems, which are often composed of numerous interactive, interrelated subsystems. Models of the subsystems are written independently and may be used together while they are still under development. Thus the models are not static. They evolve as information becomes obsolete, as improved artifact descriptions are developed, and as system capabilities change. Researchers are using three methods to support knowledge/data base growth, to track the model evolution, and to handle knowledge from diverse domains. First, the representation methodology is based on having pools, or types, of knowledge from which each model is constructed. In addition information is explicit. This includes the interactions between components, the description of the artifact structure, and the constraints and limitations of the models. The third principle we have followed is the separation of the data and knowledge from the inferencing and equation solving mechanisms. This methodology is used in two distinct knowledge-based systems: one for the design of space systems and another for the synthesis of VLSI circuits. It has facilitated the growth and evolution of our models, made accountability of results explicit, and provided credibility for the user community. These capabilities have been implemented and are being used in actual design projects. Author

N90-25526*# Lockheed Engineering and Sciences Co., Houston, TX.
TELEPRESENCE FOR SPACE: THE STATE OF THE CONCEPT **c54**
Randy L. Smith, Douglas J. Gillan, and Mark A. Stuart *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 223-228 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

The purpose here is to examine the concept of telepresence critically. To accomplish this goal, first, the assumptions that underlie telepresence and its applications are examined, and second, the issues raised by that examination are discussed. Also, these assumptions and issues are used as a means of shifting the focus in telepresence from development to user-based research. The most basic assumption of telepresence is that the information being provided to the human must be displayed in a natural fashion, i.e., the information should be displayed to the same human sensory modalities, and in the same fashion, as if the person where actually at the remote site. A further fundamental assumption for the functional use of telepresence is that a sense of being present in the work environment will produce superior performance. In other words, that sense of being there would allow the human operator of a distant machine to take greater advantage of his or her considerable perceptual, cognitive, and motor capabilities in the performance of a task than would more limited task-related feedback. Finally, a third fundamental assumption of functional telepresence is that the distant machine under the operator's control must substantially resemble a human in dexterity. Author

N90-25527*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TELEPRESENCE AND SPACE STATION FREEDOM WORKSTATION OPERATIONS **c54**
Dean G. Jensen, Susan C. Adam, James H. Stramler, and Robert P. Wilmington (Lockheed Engineering and Sciences Co., Houston, TX.) *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 229-234 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

The Space Station Freedom workstation system is a distributed network of computer based workstations that provides the man-machine interfaces for controlling space station systems. This includes control of external manipulator, robotic and free flyer devices by crewmembers in the space station's pressurized shirt-sleeve environment. These remotely controlled devices help minimize the requirement for costly crew extravehicular activity (EVA) time for such tasks as station assembly and payload support. Direct window views may be used for controlling some of the systems, but many activities will be remote or require levels of detail not possible by direct observation. Since controlling remote devices becomes more difficult when direct views are inadequate or unavailable, many performance enhancing techniques have been considered for representing information about remote activities to

the operator. Described here are the telepresence techniques under consideration to support operations and training. This includes video enhancements (e.g., graphic and text overlays and stereo viewing), machine vision systems, remote activity animation, and force reflection representation. Author

N90-25528*# Bureau of Mines, Minneapolis, MN. Human Factors Group.

THE HUMAN FACTORS OF WORKSTATION TELEPRESENCE **c54**

Thomas J. Smith and Karl U. Smith (Wisconsin Univ., Madison.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 235-250 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 05H

The term workstation telepresence has been introduced to describe human-telerobot compliance, which enables the human operator to effectively project his/her body image and behavioral skills to control of the telerobot itself. Major human-factors considerations for establishing high fidelity workstation telepresence during human-telerobot operation are discussed. Telerobot workstation telepresence is defined by the proficiency and skill with which the operator is able to control sensory feedback from direct interaction with the workstation itself, and from workstation-mediated interaction with the telerobot. Numerous conditions influencing such control have been identified. This raises the question as to what specific factors most critically influence the realization of high fidelity workstation telepresence. The thesis advanced here is that perturbations in sensory feedback represent a major source of variability in human performance during interactive telerobot operation. Perturbed sensory feedback research over the past three decades has established that spatial transformations or temporal delays in sensory feedback engender substantial decrements in interactive task performance, which training does not completely overcome. A recently developed social cybernetic model of human-computer interaction can be used to guide this approach, based on computer-mediated tracking and control of sensory feedback. How the social cybernetic model can be employed for evaluating the various modes, patterns, and integrations of interpersonal, team, and human-computer interactions which play a central role is workstation telepresence are discussed. Author

N90-25529*# Calspan Field Services, Inc., Arnold AFS, TN. AEDC Operations.

SATELLITE MATERIAL CONTAMINANT OPTICAL PROPERTIES **c74**

B. E. Wood, W. T. Bertrand, B. L. Seiber, E. L. Kiech, P. M. Falco, and J. D. Holt (Arnold Engineering Development Center, Arnold Air Force Station, TN.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 257-262 Sponsored in part by AF (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 20F

The Air Force Wright Research and Development Center and the Arnold Engineering Development Center are continuing a program for measuring optical effects of satellite material outgassing products on cryo-optic surfaces. Presented here are infrared (4000 to 700 cm(-1)) transmittance data for contaminant films condensed on a 77 K geranium window. From the transmittance data, the contaminant film refractive and absorptive indices (n, k) were derived using an analytical thin-film interference model with a nonlinear least-squares algorithm. To date 19 materials have been studied with the optical contents determined for 13 of those. The materials include adhesives, paints, composites, films, and lubricants. This program is continuing and properties for other materials will be available in the future. Author

N90-25530*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

EXPERIMENTAL INVESTIGATIONS OF LOW-ENERGY (4 TO 40 eV) COLLISIONS OF O(-)(P2) IONS AND O(P3) ATOMS WITH SURFACES **c72**

A. Chutjian, O. J. Orient, and E. Murad (Air Force Geophysics Lab., Hanscom AFB, MA.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 263-268 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 20H

Using a newly-developed, magnetically confined source, low-energy, ground state oxygen negative ions and neutral atoms are generated. The energy range is variable, and atom and neutrals have been generated at energies varying from 2 eV to 40 eV and higher. It was found that the interaction of these low-energy species with a solid magnesium fluoride target leads to optical emissions in the (at least) visible and infrared regions of the spectrum. Researchers describe y details of the photodetachment source, and present spectra of the neutral and ion glows in the wavelength range 250 to 850 nm (for O(-)) and 600 to 850 nm (for O), and discuss the variability of the emissions for incident energies between 4 and 40 eV. Author

N90-25531*# Los Alamos National Lab., NM. Chemical and Laser Sciences Div.

LABORATORY INVESTIGATIONS: LOW EARTH ORBIT ENVIRONMENT CHEMISTRY WITH SPACECRAFT SURFACES **c72**

Jon B. Cross *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 269-275 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 20H

Long-term space operations that require exposure of material to the low earth orbit (LEO) environment must take into account the effects of this highly oxidative atmosphere on material properties and the possible contamination of the spacecraft surroundings. Ground-based laboratory experiments at Los Alamos using a newly developed hyperthermal atomic oxygen (AO) source have shown that not only are hydrocarbon based materials effected but that inorganic materials such as MoS2 are also oxidized and that thin protective coatings such as Al2O3 can be breached, producing oxidation of the underlying substrate material. Gas-phase reaction products, such as SO2 from oxidation of MoS2 and CO and CO2 from hydrocarbon materials, have been detected and have consequences in terms of spacecraft contamination. Energy loss through gas-surface collisions causing spacecraft drag has been measured for a few select surfaces and has been found to be highly dependent on the surface reactivity. Author

N90-25532*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ARTIFICIAL INTELLIGENCE FOR MULTI-MISSION PLANETARY OPERATIONS **c63**

David J. Atkinson, Denise L. Lawson, and Mark L. James *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 281-287 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 09B

A brief introduction is given to an automated system called the Spacecraft Health Automated Reasoning Prototype (SHARP). SHARP is designed to demonstrate automated health and status analysis for multi-mission spacecraft and ground data systems operations. The SHARP system combines conventional computer science methodologies with artificial intelligence techniques to produce an effective method for detecting and analyzing potential spacecraft and ground systems problems. The system performs real-time analysis of spacecraft and other related telemetry, and is also capable of examining data in historical context. Telecommunications link analysis of the Voyager II spacecraft is the initial focus for evaluation of the prototype in a real-time

operations setting during the Voyager spacecraft encounter with Neptune in August, 1989. The preliminary results of the SHARP project and plans for future application of the technology are discussed. Author

N90-25533*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CLEAR: AUTOMATING CONTROL CENTERS WITH EXPERT SYSTEM TECHNOLOGY **c61**
Peter M. Hughes *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 289-293 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

The Communications Link Expert Assistance Resource (CLEAR) is a fault-isolation expert system to be utilized in the operational environment of the Cosmic Background Explorer (COBE) Mission Operations Room (MOR). CLEAR will assist the COBE Flight Operations Team (FOT) during periods of real-time data acquisition by isolating faults in the spacecraft communication link with the Tracking and Data Relay Satellite (TDRS), providing advice on how to correct them, and logging the events for post-pass evaluation. After a brief introduction to the problem domain, the system requirements, tool selection, development approach, system operation and lessons learned during the transformation of the system from the prototype to the delivered, operation system are described. Author

N90-25534*# Mitre Corp., Houston, TX.
PROCESS AND INFORMATION INTEGRATION VIA HYPERMEDIA **c61**
David G. Hammen, Daniel L. LaBasse, and Robert M. Myers *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 295-298 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

Success stories for advanced automation prototypes abound in the literature but the deployments of practical large systems are few in number. There are several factors that militate against the maturation of such prototypes into products. Here, the integration of advanced automation software into large systems is discussed. Advanced automation systems tend to be specific applications that need to be integrated and aggregated into larger systems. Systems integration can be achieved by providing expert user-developers with verified tools to efficiently create small systems that interface to large systems through standard interfaces. The use of hypermedia as such a tool in the context of the ground control centers that support Shuttle and space station operations is explored. Hypermedia can be an integrating platform for data, conventional software, and advanced automation software, enabling data integration through the display of diverse types of information and through the creation of associative links between chunks of information. Further, hypermedia enables process integration through graphical invoking of system functions. Through analysis and examples, researchers illustrate how diverse information and processing paradigms can be integrated into a single software platform. Author

N90-25535*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AN APPROACH TO A REAL-TIME DISTRIBUTION SYSTEM **c61**
Frank P. Kittle, Jr., Eddie J. Paddock, Tony Pocklington (McDonnell-Douglas Corp., Houston, TX.), and Lui Wang *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 299-303 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

The requirements of a real-time data distribution system are to provide fast, reliable delivery of data from source to destination with little or no impact to the data source. In this particular case, the data sources are inside an operational environment, the Mission Control Center (MCC), and any workstation receiving data directly from the operational computer must conform to the software standards of the MCC. In order to supply data to development workstations outside of the MCC, it is necessary to use gateway computers that prevent unauthorized data transfer back to the operational computers. Many software programs produced on the development workstations are targeted for real-time operation. Therefore, these programs must migrate from the development workstation to the operational workstation. It is yet another requirement for the Data Distribution System to ensure smooth transition of the data interfaces for the application developers. A standard data interface model has already been set up for the operational environment, so the interface between the distribution system and the application software was developed to match that model as closely as possible. The system as a whole therefore allows the rapid development of real-time applications without impacting the data sources. In summary, this approach to a real-time data distribution system provides development users outside of the MCC with an interface to MCC real-time data sources. In addition, the data interface was developed with a flexible and portable software design. This design allows for the smooth transition of new real-time applications to the MCC operational environment. Author

N90-25536*# Pittsburgh Univ., PA. Dept. of Information Science.
A COMPARISON OF TWO NEURAL NETWORK SCHEMES FOR NAVIGATION **c63**
Paul Munro *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 305-310 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

Neural networks have been applied to tasks in several areas of artificial intelligence, including vision, speech, and language. Relatively little work has been done in the area of problem solving. Two approaches to path-finding are presented, both using neural network techniques. Both techniques require a training period. Training under the back propagation (BPL) method was accomplished by presenting representations of current position, goal position pairs as input and appropriate actions as output. The Hebbian/interactive activation (HIA) method uses the Hebbian rule to associate points that are nearby. A path to a goal is found by activating a representation of the goal in the network and processing until the current position is activated above some threshold level. BPL, using back-propagation learning, failed to learn, except in a very trivial fashion, that is equivalent to table lookup techniques. HIA, performed much better, and required storage of fewer weights. In drawing a comparison, it is important to note that back propagation techniques depend critically upon the forms of representation used, and can be sensitive to parameters in the simulations; hence the BPL technique may yet yield strong results. Author

N90-25537*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE FLIGHT TELEROBOTIC SERVICER (FTS) NASA'S FIRST OPERATIONAL ROBOTIC SYSTEM **c54**
J. Andary, K. Halterman, D. Hewitt, and P. Sabelhaus *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 311-318 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

NASA has completed the preliminary definition phase of the Flight Telerobotic Servicer (FTS) and is now preparing to begin the detailed design and fabrication phase. The FTS will be designed and built by Martin Marietta Astronautics Group in Denver, CO, for the Goddard Space Flight Center, in support of the Space Station Freedom Program. The design concepts for the FTS are discussed, as well as operational scenarios for the assembly, maintenance, servicing and inspection tasks which are being considered for the FTS. The upcoming Development Test Flight

(DTF-1) is the first of two shuttle test flights to test FTS operations in the environment of space and to demonstrate the FTS capabilities in performing tasks for Space Station Freedom. Operational planning for DTF-1 is discussed as well as development plans for the operational support of the FTS on the space station. Author

N90-25538*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE TELEROBOT TESTBED: AN ARCHITECTURE FOR REMOTE SERVICING **c54**
J. R. Matijevic *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 321-328 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

The NASA/OAST Telerobot Testbed will reach its next increment in development by the end of FY-89. The testbed will have the capability for: force reflection in teleoperation, shared control, traded control, operator designate and relative update. These five capabilities will be shown in a module release and exchange operation using mockups of Orbital Replacement Units (ORU). This development of the testbed shows examples of the technologies needed for remote servicing, particularly under conditions of delay in transmissions to the servicing site. Here, the following topics are presented: the system architecture of the testbed which incorporates these telerobotic technologies for servicing, the implementation of the five capabilities and the operation of the ORU mockups. Author

N90-25539*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
PERFORMANCE-RASED WORKLOAD ASSESSMENT: ALLOCATION STRATEGY AND ADDED TASK SENSITIVITY **c53**
Michael A. Vidulich *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 329-335 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05I

The preliminary results of a research program investigating the use of added tasks to evaluate mental workload are reviewed. The focus of the first studies was a reappraisal of the traditional secondary task logic that encouraged the use of low-priority instructions for the added task. It was believed that such low-priority tasks would encourage subjects to split their available resources among the two tasks. The primary task would be assigned all the resources it needed, and any remaining reserve capacity would be assigned to the secondary task. If the model were correct, this approach was expected to combine sensitivity to primary task difficulty with unintrusiveness to primary task performance. The first studies of the current project demonstrated that a high-priority added task, although intrusive, could be more sensitive than the traditional low-priority secondary task. These results suggested that a more appropriate model of the attentional effects associated with added task performance might be based on capacity switching, rather than the traditional optimal allocation model. Author

N90-25540*# Illinois Univ., Urbana-Champaign. Dept. of Psychology.
REAL-TIME MEASUREMENT OF MENTAL WORKLOAD: A FEASIBILITY STUDY **c53**
Arthur Kramer, Darryl Humphrey, Erik Sirevaag, and Axel Mecklinger *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 339-345 (For primary document see N90-25503 19-59)
(Contract NAG2-308; N00014-89-J-1493)
Avail: NTIS HC A99/MF A04 CSCL 05I

The primary goal of the study was to explore the utility of event-related brain potentials (ERP) as real-time measures of workload. To this end, subjects performed two different tasks both separately and together. One task required that subjects monitor a bank of constantly changing gauges and detect critical deviations. Difficulty was varied by changing the predictability of the gauges. The second task was mental arithmetic. Difficulty was varied by requiring subjects to perform operations on either two or three columns of numbers. Two conditions that could easily be distinguished on the basis of performance measures were selected for the real-time evaluation of ERPs. A bootstrapping approach was adopted in which one thousand samples of n trials (n = 1, 3, 5 ...65) were classified using several measures of P300 and Slow Wave amplitude. Classification accuracies of 85 percent were achieved with 25 trials. Results are discussed in terms of potential enhancements for real-time recording. Author

N90-25541*# Illinois Univ., Urbana-Champaign. Dept. of Mechanical and Industrial Engineering.
SHAPA: AN INTERACTIVE SOFTWARE TOOL FOR PROTOCOL ANALYSIS APPLIED TO AIRCREW COMMUNICATIONS AND WORKLOAD **c61**
Jeffrey M. James, Penelope M. Sanderson, and Karen S. Seidler *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 347-352 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

As modern transport environments become increasingly complex, issues such as crew communication, interaction with automation, and workload management have become crucial. Much research is being focused on holistic aspects of social and cognitive behavior, such as the strategies used to handle workload, the flow of information, the scheduling of tasks, the verbal and non-verbal interactions between crew members. Traditional laboratory performance measures no longer sufficiently meet the needs of researchers addressing these issues. However observational techniques are better equipped to capture the type of data needed and to build models of the requisite level of sophistication. Presented here is SHAPA, an interactive software tool for performing both verbal and non-verbal protocol analysis. It has been developed with the idea of affording the researchers the closest possible degree of engagement with protocol data. The researcher can configure SHAPA to encode protocols using any theoretical framework or encoding vocabulary that is desired. SHAPA allows protocol analysis to be performed at any level of analysis, and it supplies a wide variety of tools for data aggregation, manipulation. The output generated by SHAPA can be used alone or in combination with other performance variables to get a rich picture of the influences on sequences of verbal or nonverbal behavior. Author

N90-25542*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
USEFULNESS OF HEART MEASURES IN FLIGHT SIMULATION **c52**
Randall L. Harris, Sr., Gregory A. Bonadies, and J. Raymond Comstock, Jr. *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 353-359 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 06P

The results of three studies performed at the NASA Langley Research Center are presented to indicate the areas in which heart measures are useful for detecting differences in the workload state of subjects. Tasks that involve the arousal of the sympathetic nervous system, such as landing approaches, were excellent candidates for the use of average heart-rate and/or the increase in heart-rate during a task. The latter of these two measures was the better parameter because it removed the effects of diurnal variations in heart-rate and some of the intersubject variability. Tasks which differ in the amount of mental resources required are excellent candidates for heart-rate variability measures. Heart-rate variability measures based upon power spectral density techniques were responsive to the changing task demands of landing approach tasks, approach guidance options, and 2 versus 20 second interstimulus-intervals of a monitoring task. Heart-rate

variability measures were especially sensitive to time-on-task when the task was characterized by minimal novelty, complexity, and uncertainty (i.e., heart-rate variability increases as a function of the subjects boredom). Author

N90-25543*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SPACE ENVIRONMENTS AND THEIR EFFECTS ON SPACE AUTOMATION AND ROBOTICS **c18**
Henry B. Garrett *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 361-380 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

Automated and robotic systems will be exposed to a variety of environmental anomalies as a result of adverse interactions with the space environment. As an example, the coupling of electrical transients into control systems, due to EMI from plasma interactions and solar array arcing, may cause spurious commands that could be difficult to detect and correct in time to prevent damage during critical operations. Spacecraft glow and space debris could introduce false imaging information into optical sensor systems. The presentation provides a brief overview of the primary environments (plasma, neutral atmosphere, magnetic and electric fields, and solid particulates) that cause such adverse interactions. The descriptions, while brief, are intended to provide a basis for the other papers presented at this conference which detail the key interactions with automated and robotic systems. Given the growing complexity and sensitivity of automated and robotic space systems, an understanding of adverse space environments will be crucial to mitigating their effects. Author

N90-25544*# TRW Space Technology Labs., Redondo Beach, CA.
DISCHARGE TRANSIENT COUPLING IN LARGE SPACE POWER SYSTEMS **c20**
N. John Stevens and R. P. Stillwell *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 383-391 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10B

Experiments have shown that plasma environments can induce discharges in solar arrays. These plasmas simulate the environments found in low earth orbits where current plans call for operation of very large power systems. The discharges could be large enough to couple into the power system and possibly disrupt operations. Here, the general concepts of the discharge mechanism and the techniques of coupling are discussed. Data from both ground and flight experiments are reviewed to obtain an expected basis for the interactions. These concepts were applied to the Space Station solar array and distribution system as an example of the large space power system. The effect of discharges was found to be a function of the discharge site. For most sites in the array discharges would not seriously impact performance. One location at the negative end of the array was identified as a position where discharges could couple to charge stored in system capacitors. This latter case could impact performance. Author

N90-25545*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PLASMA INTERACTIONS AND EFFECTS FOR LARGE SYSTEMS **c75**
David B. Snyder *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 393-404 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 20I

Information on plasma-spacecraft interactions and the effects on spacecraft systems and materials is given in viewgraph form. Information is given on plasma characteristics, ionospheric charge density, spacecraft floating potential, floating potentials of self-biased solar arrays, and geosynchronous earth orbit issues. Author

N90-25546*# Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.
A TASK CONTROL ARCHITECTURE FOR AUTONOMOUS ROBOTS **c63**
Reid Simmons and Tom Mitchell *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 409-414 (For primary document see N90-25503 19-59)
(Grant NAGw-1175)
Avail: NTIS HC A99/MF A04 CSCL 09B

An architecture is presented for controlling robots that have multiple tasks, operate in dynamic domains, and require a fair degree of autonomy. The architecture is built on several layers of functionality, including a distributed communication layer, a behavior layer for querying sensors, expanding goals, and executing commands, and a task level for managing the temporal aspects of planning and achieving goals, coordinating tasks, allocating resources, monitoring, and recovering from errors. Application to a legged planetary rover and an indoor mobile manipulator is described. Author

N90-25547*# Decision-Science Applications, Inc., Arlington, VA.
AUTOMATED CONTROL OF HIERARCHICAL SYSTEMS USING VALUE-DRIVEN METHODS **c61**
George E. Pugh and Thomas E. Burke *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 415-422 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

An introduction is given to the Value-driven methodology, which has been successfully applied to solve a variety of difficult decision, control, and optimization problems. Many real-world decision processes (e.g., those encountered in scheduling, allocation, and command and control) involve a hierarchy of complex planning considerations. For such problems it is virtually impossible to define a fixed set of rules that will operate satisfactorily over the full range of probable contingencies. Decision Science Applications' value-driven methodology offers a systematic way of automating the intuitive, common-sense approach used by human planners. The inherent responsiveness of value-driven systems to user-controlled priorities makes them particularly suitable for semi-automated applications in which the user must remain in command of the systems operation. Three examples of the practical application of the approach in the automation of hierarchical decision processes are discussed: the TAC Brawler air-to-air combat simulation is a four-level computerized hierarchy; the autonomous underwater vehicle mission planning system is a three-level control system; and the Space Station Freedom electrical power control and scheduling system is designed as a two-level hierarchy. The methodology is compared with rule-based systems and with other more widely-known optimization techniques. Author

N90-25548*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PLANNING FOR EXECUTION MONITORING ON A PLANETARY ROVER **c63**
Erann Gat, R. James Firby, and David P. Miller *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 423-427 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

A planetary rover will be traversing largely unknown and often unknowable terrain. In addition to geometric obstacles such as cliffs, rocks, and holes, it may also have to deal with non-geometric hazards such as soft soil and surface breakthroughs which often cannot be detected until rover is in imminent danger. Therefore, the rover must monitor its progress throughout a traverse, making sure to stay on course and to detect and act on any previously unseen hazards. Its onboard planning system must decide what sensors to monitor, what landmarks to take position readings from, and what actions to take if something should go wrong. The

planning systems being developed for the Pathfinder Planetary Rover to perform these execution monitoring tasks are discussed. This system includes a network of planners to perform path planning, expectation generation, path analysis, sensor and reaction selection, and resource allocation. Author

N90-25549*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
IMPACT OF END EFFECTOR TECHNOLOGY ON TELEMANIPULATION PERFORMANCE **c37**
A. K. Bejczy, Z. Szakaly, and T. Ohm *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 429-440 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 13I

Generic requirements for end effector design are briefly summarized as derived from generic functional and operational requirements. Included is a brief summary of terms and definitions related to end effector technology. The second part contains a brief overview of end effector technology work as JPL during the past ten years, with emphasis on the evolution of new mechanical, sensing and control capabilities of end effectors. The third and major part is devoted to the description of current end effector technology. The ongoing work addresses mechanical, sensing and control details with emphasis on mechanical ruggedness, increased resolution in sensing, and close electronic and control integration with overall telemanipulator control system. Author

N90-25550*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SMART HANDS FOR THE EVA RETRIEVER **c37**
Clifford W. Hess and Larry C. Li *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 441-446 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 13I

Dexterous, robotic hands are required for the extravehicular activity retriever (EVAR) system being developed by the NASA Johnson Space Center (JSC). These hands, as part of the EVAR system, must be able to grasp objects autonomously and securely which inadvertently separate from the Space Station. Development of the required hands was initiated in 1987. Outlined here are the hand development activities, including design considerations, progress to date, and future plans. Several types of dexterous hands that were evaluated, along with a proximity-sensing capability that was developed to initiate a reflexive, adaptive grasp, are described. The evaluations resulted in the design and fabrication of a 6-degree-of-freedom (DOF) hand that has two fingers and a thumb arranged in an anthropomorphic configuration. Finger joint force and position sensors are included in the design, as well as infrared proximity sensors which allow initiation of the grasp sequence when an object is detected within the grasp envelope. Author

N90-25551*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
KINEMATICALLY REDUNDANT ARM FORMULATIONS FOR COORDINATED MULTIPLE ARM IMPLEMENTATIONS **c37**
Robert W. Bailey, Leslie J. Quiocho (LinCom Corp., Houston, TX.), and Timothy F. Cleghorn *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 447-454 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 13I

Although control laws for kinematically redundant robotic arms were presented as early as 1969, redundant arms have only recently become recognized as viable solutions to limitations inherent to kinematically sufficient arms. The advantages of run-time control optimization and arm reconfiguration are becoming increasingly attractive as the complexity and criticality of robotic systems continues to progress. A generalized control law for a spatial arm with 7 or more degrees of freedom (DOF) based on Whitney's resolved rate formulation is given. Results from a simulation implementation utilizing this control law are presented. Furthermore, results from a two arm simulation are presented to demonstrate the coordinated control of multiple arms using this formulation. Author

N90-25552*# Kellogg (M. W.) Co., Houston, TX.
NUMERICAL APPROACH OF COLLISION AVOIDANCE AND OPTIMAL CONTROL ON ROBOTIC MANIPULATORS **c63**
Jyhshing Jack Wang *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 455-464 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

Collision-free optimal motion and trajectory planning for robotic manipulators are solved by a method of sequential gradient restoration algorithm. Numerical examples of a two degree-of-freedom (DOF) robotic manipulator are demonstrated to show the excellence of the optimization technique and obstacle avoidance scheme. The obstacle is put on the midway, or even further inward on purpose, of the previous no-obstacle optimal trajectory. For the minimum-time purpose, the trajectory grazes by the obstacle and the minimum-time motion successfully avoids the obstacle. The minimum-time is longer for the obstacle avoidance cases than the one without obstacle. The obstacle avoidance scheme can deal with multiple obstacles in any ellipsoid forms by using artificial potential fields as penalty functions via distance functions. The method is promising in solving collision-free optimal control problems for robotics and can be applied to any DOF robotic manipulators with any performance indices and mobile robots as well. Since this method generates optimum solution based on Pontryagin Extremum Principle, rather than based on assumptions, the results provide a benchmark against which any optimization techniques can be measured. Author

N90-25553*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VISUALIZATION OF THREE DIMENSIONAL DATA **c74**
Stephen R. Ellis, Stephen Smith, and Selim Hacisalihzade *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 465-469 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 20F

The objective of research is to characterize patterns of errors observers make when relating the judged exocentric direction of a target presented on a perspective display to their egocentric sense of visual direction. This type of spatial task is commonly faced by operators of telerobotic systems when using a map-like display of their workspace to determine the visual location and orientation of objects seen by direct view. It is also essentially the same task as faced by an aircraft pilot using a cockpit perspective traffic display of his surrounding airspace to locate traffic out his windows. The results of the current study clearly show that the visual direction is a significantly biased metric of virtual space presented by flat panel perspective displays. Modeling and explanation of the causes of the observed biases will allow design of compensated perspective displays. Author

N90-25554*# Sterling Software, Moffett Field, CA.
REMOTE OPERATION OF AN ORBITAL MANEUVERING VEHICLE IN SIMULATED DOCKING MANEUVERS **c18**
Adam R. Brody *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 471-475 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

Simulated docking maneuvers were performed to assess the effect of initial velocity on docking failure rate, mission duration, and delta v (fuel consumption). Subjects performed simulated docking maneuvers of an orbital maneuvering vehicle (OMV) to a space station. The effect of the removal of the range and rate displays (simulating a ranging instrumentation failure) was also examined. Naive subjects were capable of achieving a high success

rate in performing simulated docking maneuvers without extensive training. Failure rate was a function of individual differences; there was no treatment effect on failure rate. The amount of time subjects reserved for final approach increased with starting velocity. Piloting of docking maneuvers was not significantly affected in any way by the removal of range and rate displays. Radial impulse was significant both by subject and by treatment. NASA's 0.1 percent rule, dictating an approach rate no greater than 0.1 percent of the range, is seen to be overly conservative for nominal docking missions. Author

N90-25555*# California Univ., Berkeley. Telerobotics Unit.
A HELMET MOUNTED DISPLAY TO ADAPT THE TELEROBOTIC ENVIRONMENT TO HUMAN VISION c54
Gregory Tharp, Andrew Liu, Hitomi Yamashita, and Lawrence Stark *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 477-481 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

A Helmet Mounted Display system has been developed. It provides the capability to display stereo images with the viewpoint tied to subjects' head orientation. The type of display might be useful in a telerobotic environment provided the correct operating parameters are known. The effects of update frequency were tested using a 3D tracking task. The effects of blur were tested using both tracking and pick-and-place tasks. For both, researchers found that operator performance can be degraded if the correct parameters are not used. Researchers are also using the display to explore the use of head movements as part of gaze as subjects search their visual field for target objects. Author

N90-25556*# Carlow Associates, Inc., Fairfax, VA.
HUMAN FACTORS ISSUES IN TELEROBOTIC SYSTEMS FOR SPACE STATION FREEDOM SERVICING c54
Thomas B. Malone and Kathryn E. Permenter *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 485-492 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05H

Requirements for Space Station Freedom servicing are described and the state-of-the-art for telerobotic system on-orbit servicing of spacecraft is defined. The projected requirements for the Space Station Flight Telerobotic Servicer (FTS) are identified. Finally, the human factors issues in telerobotic servicing are discussed. The human factors issues are basically three: the definition of the role of the human versus automation in system control; the identification of operator-device interface design requirements; and the requirements for development of an operator-machine interface simulation capability. Author

N90-25557*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTERACTIONS BETWEEN THE SPACE STATION AND THE ENVIRONMENT: A PRELIMINARY ASSESSMENT OF EMI c18
G. B. Murphy and Henry B. Garrett *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 493-507 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 22B

A review of the interactions between proposed Space Station systems/payloads and the environment that contribute to electromagnetic interference was performed. Seven prime sources of interference have been identified. These are: The Space Station power system; active experiments such as beam injection; ASTROMAG; ram and wake density gradients; pick up ions produced by vented or offgassed clouds; waves produced by current loops that include the plasma and structure; arcing from high voltage solar arrays (or possible ESD in polar orbit). This review indicates that: minimizing leakage current from the 20 kHz power system to the structure; keeping the surfaces of the Space Station structure, arrays, and radiators nonconducting; minimizing venting of payloads or systems to non-operational periods; careful placement of payloads sensitive to magnetic field perturbations or wake noise; and designing an operational timeline compatible with experiment requirement are the most effective means of minimizing the effects of this interference. High degrees of uncertainty exist in the estimates of magnitudes of gas emission induced EMI, radiation of 20 kHz and harmonics, ASTROMAG induced interference, and arc threshold/frequency of the solar array. These processes demand further attention so that mitigation efforts are properly calibrated. Author

N90-25558*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SOLAR ARRAY ARCING IN PLASMAS c44
Dale C. Ferguson *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 509-513 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10A

Solar cells in space plasma conditions are known to arc into the plasma when the interconnects are at a negative potential of a few hundred volts, relative to plasma potential. For cells with silver-coated interconnects, a threshold voltage for arcing exists at about -230 V, as found in both ground and LEO experiments. The arc rate beyond the threshold voltage depends nearly linearly on plasma density, but has a strong power-law dependence on voltage, such that for small increments in operating voltage there is a large increment in arc rate. The arcs generate broadband radio interference and visible light. In ground tests, interconnects have been damaged by arcs in cells having insufficient isolation from a source of high current. Models for the arcs are highly dependent on the choice of interconnect conductor material exposed to the plasma and possibly on the geometry and choice of adjacent insulator material. Finally, new technology solar cells use copper for the cell interconnects, a material which may have a lower arcing threshold voltage than silver. It is expected, from ground tests of simulated solar cells, that any junction of conductor and insulator exposed to space plasma conditions will arc into the plasma at a few hundred volts negative potential, relative to the local plasma. Author

N90-25559*# Air Force Geophysics Lab., Hanscom AFB, MA.
PHOTOVOLTAIC ARRAY SPACE POWER PLUS DIAGNOSTICS EXPERIMENT c44
Donald A. Guidice *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 515-519 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 10A

The objective of the Photovoltaic Array Space Power Plus Diagnostics (PASP Plus) experiment is to measure the effects of the interaction of the low- to mid-altitude space environment on the performance of a diverse set of small solar-cell arrays (planar and concentrator, representative of present and future military technologies) under differing conditions of velocity-vector orientation and simulated (by biasing) high-voltage operation. Solar arrays to be tested include Si and GaAs planar arrays and several types of GaAs concentrator arrays. Diagnostics (a Langmuir probe and a pressure gauge) and a transient pulse monitor (to measure radiated and conducted EMI during arcing) will be used to determine the impact of the environment on array operation to help verify various interactions models. Results from a successful PASP Plus flight will furnish answers to important interactions questions and provide inputs for design and test standards for photovoltaic space-power subsystems. Author

N90-25560*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SUNSPOT PREDICTION USING NEURAL NETWORKS c92
James Villarreal and Paul Baffes *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 525-535 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 03B

The earliest systematic observance of sunspot activity is known to have been discovered by the Chinese in 1382 during the Ming Dynasty (1368 to 1644) when spots on the sun were noticed by looking at the sun through thick, forest fire smoke. Not until after the 18th century did sunspot levels become more than a source of wonderment and curiosity. Since 1834 reliable sunspot data has been collected by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Naval Observatory. Recently, considerable effort has been placed upon the study of the effects of sunspots on the ecosystem and the space environment. The efforts of the Artificial Intelligence Section of the Mission Planning and Analysis Division of the Johnson Space Center involving the prediction of sunspot activity using neural network technologies are described. Author

N90-25561*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

BEHAVIORAL NETWORKS AS A MODEL FOR INTELLIGENT AGENTS **c63**

Nancy E. Sliwa *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 537-542 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 09B

On-going work at NASA Langley Research Center in the development and demonstration of a paradigm called behavioral networks as an architecture for intelligent agents is described. This work focuses on the need to identify a methodology for smoothly integrating the characteristics of low-level robotic behavior, including actuation and sensing, with intelligent activities such as planning, scheduling, and learning. This work assumes that all these needs can be met within a single methodology, and attempts to formalize this methodology in a connectionist architecture called behavioral networks. Behavioral networks are networks of task processes arranged in a task decomposition hierarchy. These processes are connected by both command/feedback data flow, and by the forward and reverse propagation of weights which measure the dynamic utility of actions and beliefs. Author

N90-25562*# Ford Aerospace and Communications Corp., Sunnyvale, CA.

OMS FDIR: INITIAL PROTOTYPING **c81**

Eric W. Taylor and Matthew A. Hanson *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 545-549 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 05A

The Space Station Freedom Program (SSFP) Operations Management System (OMS) will automate major management functions which coordinate the operations of onboard systems, elements and payloads. The objectives of OMS are to improve safety, reliability and productivity while reducing maintenance and operations cost. This will be accomplished by using advanced automation techniques to automate much of the activity currently performed by the flight crew and ground personnel. OMS requirements have been organized into five task groups: (1) Planning, Execution and Replanning; (2) Data Gathering, Preprocessing and Storage; (3) Testing and Training; (4) Resource Management; and (5) Caution and Warning and Fault Management for onboard subsystems. The scope of this prototyping effort falls within the Fault Management requirements group. The prototyping will be performed in two phases. Phase 1 is the development of an onboard communications network fault detection, isolation, and reconfiguration (FDIR) system. Phase 2 will incorporate global FDIR for onboard systems. Research into the applicability of expert systems, object-oriented programming, fuzzy sets, neural networks and other advanced techniques will be conducted. The goals and technical approach for this new SSFP research project are discussed here. Author

N90-25563*# Michigan Univ., Ann Arbor. Artificial Intelligence Lab.

THE APPLICATION OF NASREM TO REMOTE ROBOT CONTROL **c63**

Michael W. Walker, Joe Dionise, and Al Dobryden *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 551-557 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 09B

The implementation of a remote robot controller, wherein the distance to the remote robot causes significant communication time delays is described. The NASREM telrobot control architecture is used as a basis for the implementation of the system. Levels 1 through 4 of the hierarchy were implemented. The solution to the problems encounterd during the implementation and those which are unique to remote robot control are described. Author

N90-25564*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

TECHNOLOGY FOR AN INTELLIGENT, FREE-FLYING ROBOT FOR CREW AND EQUIPMENT RETRIEVAL IN SPACE **c18**

J. D. Erickson, G. J. Reuter, Kathleen J. Healey, and D. E. Phinney (Lockheed Engineering and Sciences Co., Houston, TX.) *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 559-565 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 22B

Crew rescue and equipment retrieval is a Space Station Freedom requirement. During Freedom's lifetime, there is a high probability that a number of objects will accidently become separated. Members of the crew, replacement units, and key tools are examples. Retrieval of these objects within a short time is essential. Systems engineering studies were conducted to identify system requirements and candidate approaches. One such approach, based on a voice-supervised, intelligent, free-flying robot was selected for further analysis. A ground-based technology demonstration, now in its second phase, was designed to provide an integrated robotic hardware and software testbed supporting design of a space-borne system. The ground system, known as the EVA Retriever, is examining the problem of autonomously planning and executing a target rendezvous, grapple, and return to base while avoiding stationary and moving obstacles. The current prototype is an anthropomorphic manipulator unit with dexterous arms and hands attached to a robot body and latched in a manned maneuvering unit. A precision air-bearing floor is used to simulate space. Sensor data include two vision systems and force/proximity/tactile sensors on the hands and arms. Planning for a shuttle file experiment is underway. A set of scenarios and strawman requirements were defined to support conceptual development. Initial design activities are expected to begin in late 1989 with the flight occurring in 1994. The flight hardware and software will be based on lessons learned from both the ground prototype and computer simulations. Author

N90-25565*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE JPL TELEROBOT OPERATOR CONTROL STATION: OPERATIONAL EXPERIENCES **c54**

Edwin P. Kan *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 567-575 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 05H

The Operator Control Station of the JPL/NASA Telerobot Demonstration System provides an efficient man-machine interface for the performance of telerobot tasks. Its hardware and software have been designed with high flexibility. It provides a feedback-rich interactive environment in which the Operator performs teleoperation tasks, robotic tasks, and telerobotic tasks with ease. The to-date operational experiences of this system, particularly related to the Object Designate Process and the Voice Input/Output Process are discussed. Author

N90-25566*# University of Central Florida, Orlando.
AN INTELLIGENT SIMULATION TRAINING SYSTEM **c09**
John E. Biegel *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 579-584 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 14B

The Department of Industrial Engineering at the University of Central Florida, Embry-Riddle Aeronautical University and General Electric (SCSD) have been funded by the State of Florida to build an Intelligent Simulation Training System. The objective was and is to make the system generic except for the domain expertise. Researchers accomplished this objective in their prototype. The system is modularized and therefore it is easy to make any corrections, expansions or adaptations. The funding by the state of Florida has exceeded $3 million over the past three years and through the 1990 fiscal year. UCF has expended in excess of 15 work years on the project. The project effort has been broken into three major tasks. General Electric provides the simulation. Embry-Riddle Aeronautical University provides the domain expertise. The University of Central Florida has constructed the generic part of the system which is comprised of several modules that perform the tutoring, evaluation, communication, status, etc. The generic parts of the Intelligent Simulation Training Systems (ISTS) are described. Author

N90-25567*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FUNCTIONAL DESCRIPTION OF A COMMAND AND CONTROL LANGUAGE TUTOR **c63**
David R. Elke, Thomas L. Seamster (Carlow Associates, Inc., Fairfax, VA.), and Walter Truszkowski *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 585-592 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

The status of an ongoing project to explore the application of Intelligent Tutoring System (ITS) technology to NASA command and control languages is described. The primary objective of the current phase of the project is to develop a user interface for an ITS to assist NASA control center personnel in learning Systems Test and Operations Language (STOL). Although this ITS will be developed for Gamma Ray Observatory operators, it will be designed with sufficient flexibility so that its modules may serve as an ITS for other control languages such as the User Interface Language (UIL). The focus of this phase is to develop at least one other form of STOL representation to complement the operational STOL interface. Such an alternative representation would be adaptively employed during the tutoring session to facilitate the learning process. This is a key feature of this ITS which distinguishes it from a simulator that is only capable of representing the operational environment. Author

N90-25568*# Air Force Human Resources Lab., Brooks AFB, TX. Manpower and Personnel Div.
SUCCESS IN TUTORING ELECTRONIC TROUBLESHOOTING **c63**
Ellen M. Parker *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 593-603 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

Two years ago Dr. Sherrie Gott of the Air Force Human Resources Laboratory described an avionics troubleshooting tutor being developed under the Basic Job Skills Research Program. The tutor, known as Sherlock, is directed at teaching the diagnostic procedures necessary to investigate complex test equipment used to maintain F-15 fighter aircraft. Since Dr. Gott's presentation in 1987, the tutor has undergone field testing at two Air Force F-15 flying wings. The results of the field test showed that after an average of 20 hours on the tutor, the 16 airmen in the experimental group (who average 28 months of experience) showed significant performance gains when compared to a control group (having a mean experience level of 37 months) who continued participating in the existing on-the-job training program. Troubleshooting performance of the tutored group approached the level of proficiency of highly experienced airmen (averaging approximately 114 months of experience), and these performance gains were confirmed in delayed testing six months following the intervention. The tutor is currently undergoing a hardware and software conversion form a Xerox Lisp environment to a PC-based environment using an object-oriented programming language. Summarized here are the results of the successful field test. The focus is on: (1) the instructional features that contributed to Sherlock's success; and (2) the implementation of these features in the PC-based version of the avionics troubleshooting tutor.
Author

N90-25569*# BDM Corp., Huntsville, AL.
A MODEL FOR A KNOWLEDGE-BASED SYSTEM'S LIFE CYCLE **c63**
Peter A. Kiss *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 605-610 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

The American Institute of Aeronautics and Astronautics has initiated a Committee on Standards for Artificial Intelligence. Presented here are the initial efforts of one of the working groups of that committee. The purpose here is to present a candidate model for the development life cycle of Knowledge Based Systems (KBS). The intent is for the model to be used by the Aerospace Community and eventually be evolved into a standard. The model is rooted in the evolutionary model, borrows from the spiral model, and is embedded in the standard Waterfall model for software development. Its intent is to satisfy the development of both stand-alone and embedded KBSs. The phases of the life cycle are detailed as are and the review points that constitute the key milestones throughout the development process. The applicability and strengths of the model are discussed along with areas needing further development and refinement by the aerospace community.
Author

N90-25570*# Air Force Logistics Command, Wright-Patterson AFB, OH.
KNOWLEDGE-BASED SYSTEMS (KBS) DEVELOPMENT STANDARDS: A MAINTENANCE PERSPECTIVE **c63**
John Brill *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 611-630 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

Information on knowledge-based systems (KBS) is given in viewgraph form. Information is given on KBS standardization needs, the knowledge engineering process, program management, software and hardware issues, and chronic problem areas.
Author

N90-25571*# International Business Machines Corp., Houston, TX. Systems Integration Div.
ACES: SPACE SHUTTLE FLIGHT SOFTWARE ANALYSIS EXPERT SYSTEM **c61**
R. Scott Satterwhite *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 633-636 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

The Analysis Criteria Evaluation System (ACES) is a knowledge based expert system that automates the final certification of the Space Shuttle onboard flight software. Guidance, navigation and control of the Space Shuttle through all its flight phases are accomplished by a complex onboard flight software system. This software is reconfigured for each flight to allow thousands of mission-specific parameters to be introduced and must therefore be thoroughly certified prior to each flight. This certification is performed in ground simulations by executing the software in the

flight computers. Flight trajectories from liftoff to landing, including abort scenarios, are simulated and the results are stored for analysis. The current methodology of performing this analysis is repetitive and requires many man-hours. The ultimate goals of ACES are to capture the knowledge of the current experts and improve the quality and reduce the manpower required to certify the Space Shuttle onboard flight software. Author

N90-25572*# Wisconsin Univ., Madison. Center for Space Automation and Robotics.

TEST BED EXPERIMENTS FOR VARIOUS TELEROBOTIC SYSTEM CHARACTERISTICS AND CONFIGURATIONS **c37**

Neil A. Duffie, Steven F. Wiker, and John J. Zik *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 637-644 (For primary document see N90-25503 19-59)

(Grant NAGw-975)

Avail: NTIS HC A99/MF A04 CSCL 13I

Dexterous manipulation and grasping in telerobotic systems depends on the integration of high-performance sensors, displays, actuators and controls into systems in which careful consideration has been given to human perception and tolerance. Research underway at the Wisconsin Center for Space Automation and Robotics (WCSAR) has the objective of enhancing the performance of these systems and their components, and quantifying the effects of the many electrical, mechanical, control, and human factors that affect their performance. This will lead to a fundamental understanding of performance issues which will in turn allow designers to evaluate sensor, actuator, display, and control technologies with respect to generic measures of dexterous performance. As part of this effort, an experimental test bed was developed which has telerobotic components with exceptionally high fidelity in master/slave operation. A Telerobotic Performance Analysis System has also been developed which allows performance to be determined for various system configurations and electro-mechanical characteristics. Both this performance analysis system and test bed experiments are described. Author

N90-25573*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A LABORATORY BREADBOARD SYSTEM FOR DUAL-ARM TELEOPERATION **c63**

A. K. Bejczy, Z. Szakaly, and W. S. Kim *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 649-660 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 09B

The computing architecture of a novel dual-arm teleoperation system is described. The novelty of this system is that: (1) the master arm is not a replica of the slave arm; it is unspecific to any manipulator and can be used for the control of various robot arms with software modifications; and (2) the force feedback to the general purpose master arm is derived from force-torque sensor data originating from the slave hand. The computing architecture of this breadboard system is a fully synchronized pipeline with unique methods for data handling, communication and mathematical transformations. The computing system is modular, thus inherently extendable. The local control loops at both sites operate at 100 Hz rate, and the end-to-end bilateral (force-reflecting) control loop operates at 200 Hz rate, each loop without interpolation. This provides high-fidelity control. This end-to-end system elevates teleoperation to a new level of capabilities via the use of sensors, microprocessors, novel electronics, and real-time graphics displays. A description is given of a graphic simulation system connected to the dual-arm teleoperation breadboard system. High-fidelity graphic simulation of a telerobot (called Phantom Robot) is used for preview and predictive displays for planning and for real-time control under several seconds communication time delay conditions. High fidelity graphic simulation is obtained by using appropriate calibration techniques. Author

N90-25574*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

PROCESS AND REPRESENTATION IN GRAPHICAL DISPLAYS **c61**

Douglas J. Gillan, Robert Lewis (Rice Univ., Houston, TX.), and Marianne Rudisill *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 661-665 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 09B

How people comprehend graphics is examined. Graphical comprehension involves the cognitive representation of information from a graphic display and the processing strategies that people apply to answer questions about graphics. Research on representation has examined both the features present in a graphic display and the cognitive representation of the graphic. The key features include the physical components of a graph, the relation between the figure and its axes, and the information in the graph. Tests of people's memory for graphs indicate that both the physical and informational aspect of a graph are important in the cognitive representation of a graph. However, the physical (or perceptual) features overshadow the information to a large degree. Processing strategies also involve a perception-information distinction. In order to answer simple questions (e.g., determining the value of a variable, comparing several variables, and determining the mean of a set of variables), people switch between two information processing strategies: (1) an arithmetic, look-up strategy in which they use a graph much like a table, looking up values and performing arithmetic calculations; and (2) a perceptual strategy in which they use the spatial characteristics of the graph to make comparisons and estimations. The user's choice of strategies depends on the task and the characteristics of the graph. A theory of graphic comprehension is presented. Author

N90-25575*# Martin Marietta Aerospace, Denver, CO. Astronautics Group.

EVALUATION OF OFF-ROAD TERRAIN WITH STATIC STEREO AND MONOSCOPIC DISPLAYS **c63**

John P. Yorchak and Craig S. Hartley *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 671-678 (For primary document see N90-25503 19-59)

Avail: NTIS HC A99/MF A04 CSCL 09B

The National Aeronautics and Space Administration is currently funding research into the design of a Mars rover vehicle. This unmanned rover will be used to explore a number of scientific and geologic sites on the Martian surface. Since the rover can not be driven from Earth in real-time, due to lengthy communication time delays, a locomotion strategy that optimizes vehicle range and minimizes potential risk must be developed. In order to assess the degree of on-board artificial intelligence (AI) required for a rover to carry out its' mission, researchers conducted an experiment to define a no AI baseline. In the experiment 24 subjects, divided into stereo and monoscopic groups, were shown video snapshots of four terrain scenes. The subjects' task was to choose a suitable path for the vehicle through each of the four scenes. Paths were scored based on distance travelled and hazard avoidance. Study results are presented with respect to: (1) risk versus range; (2) stereo versus monocular video; (3) vehicle camera height; and (4) camera field-of-view. Author

N90-25576*# Tulane Univ., New Orleans, LA. Dept. of Computer Science.

OCEAN FEATURE RECOGNITION USING GENETIC ALGORITHMS WITH FUZZY FITNESS FUNCTIONS (GA/F3) **c48**

C. A. Ankenbrandt, B. P. Buckles, F. E. Petry, and M. Lybanon (Naval Ocean Research and Development Activity, Bay Saint Louis, MS.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 679-685 (For primary document see N90-25503 19-59)

(Contract N00014-89-J-6003)

Avail: NTIS HC A99/MF A04 CSCL 08C

A model for genetic algorithms with semantic nets is derived for which the relationships between concepts is depicted as a semantic net. An organism represents the manner in which objects in a scene are attached to concepts in the net. Predicates between object pairs are continuous valued truth functions in the form of an inverse exponential function (e sub beta lxl). 1:n relationships are combined via the fuzzy OR (Max (...)). Finally, predicates between pairs of concepts are resolved by taking the average of the combined predicate values of the objects attached to the concept at the tail of the arc representing the predicate in the semantic net. The method is illustrated by applying it to the identification of oceanic features in the North Atlantic. Author

N90-25577*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EXTENSIONS OF ALGEBRAIC IMAGE OPERATORS: AN APPROACH TO MODEL-BASED VISION **c63**
Bao-Ting Lerner and Michael V. Morelli (Fairleigh Dickinson Univ., Teaneck, NJ.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 687-695 (For primary document see N90-25503 19-59)
(NASA Order S-92580-D)
Avail: NTIS HC A99/MF A04 CSCL 09B

Researchers extend their previous research on a highly structured and compact algebraic representation of grey-level images which can be viewed as fuzzy sets. Addition and multiplication are defined for the set of all grey-level images, which can then be described as polynomials of two variables. Utilizing this new algebraic structure, researchers devised an innovative, efficient edge detection scheme. An accurate method for deriving gradient component information from this edge detector is presented. Based upon this new edge detection system researchers developed a robust method for linear feature extraction by combining the techniques of a Hough transform and a line follower. The major advantage of this feature extractor is its general, object-independent nature. Target attributes, such as line segment lengths, intersections, angles of intersection, and endpoints are derived by the feature extraction algorithm and employed during model matching. The algebraic operators are global operations which are easily reconfigured to operate on any size or shape region. This provides a natural platform from which to pursue dynamic scene analysis. A method for optimizing the linear feature extractor which capitalizes on the spatially reconfiguration nature of the edge detector/gradient component operator is discussed. Author

N90-25578*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
EXECUTION TIME SUPPORTS FOR ADAPTIVE SCIENTIFIC ALGORITHMS ON DISTRIBUTED MEMORY MACHINES Final Report
Harry Berryman, Joel Saltz, and Jeffrey Scroggs May 1990 21 p Submitted for publication
(Contracts NAS1-18605; N00014-86-K-0310)
(NASA-CR-182052; NAS 1.26:182052; ICASE-90-41) Avail: NTIS HC A03/MF A01 CSCL 12A

Optimizations are considered that are required for efficient execution of code segments that consists of loops over distributed data structures. The PARTI (Parallel Automated Runtime Toolkit at ICASE) execution time primitives are designed to carry out these optimizations and can be used to implement a wide range of scientific algorithms on distributed memory machines. These primitives allow the user to control array mappings in a way that gives an appearance of shared memory. Computations can be based on a global index set. Primitives are used to carry out gather and scatter operations on distributed arrays. Communications patterns are derived at runtime, and the appropriate send and receive messages are automatically generated. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N90-25579*# Toledo Univ., OH. Dept. of Computer Science and Engineering.
MULTIPROCESSOR ARCHITECTURE: SYNTHESIS AND EVALUATION
Hilda M. Standley 1990 5 p
(Grant NAG3-699)
(NASA-CR-186618; NAS 1.26:186618) Avail: NTIS HC A01/MF A01 CSCL 09B

Multiprocessor computed architecture evaluation for structural computations is the focus of the research effort described. Results obtained are expected to lead to more efficient use of existing architectures and to suggest designs for new, application specific, architectures. The brief descriptions given outline a number of related efforts directed toward this purpose. The difficulty is analyzing an existing architecture or in designing a new computer architecture lies in the fact that the performance of a particular architecture, within the context of a given application, is determined by a number of factors. These include, but are not limited to, the efficiency of the computation algorithm, the programming language and support environment, the quality of the program written in the programming language, the multiplicity of the processing elements, the characteristics of the individual processing elements, the interconnection network connecting processors and non-local memories, and the shared memory organization covering the spectrum from no shared memory (all local memory) to one global access memory. These performance determiners may be loosely classified as being software or hardware related. This distinction is not clear or even appropriate in many cases. The effect of the choice of algorithm is ignored by assuming that the algorithm is specified as given. Effort directed toward the removal of the effect of the programming language and program resulted in the design of a high-level parallel programming language. Two characteristics of the fundamental structure of the architecture (memory organization and interconnection network) are examined. Author

N90-25580*# Stevens Inst. of Tech., Hoboken, NJ.
HARDWARE AND SOFTWARE RELIABILITY ESTIMATION USING SIMULATIONS Final Report
Frederic L. Swern Jun. 1990 152 p
(Grant NAG1-587)
(NASA-CR-186637; NAS 1.26:186637) Avail: NTIS HC A08/MF A01 CSCL 09B

The overall objective is to provide estimates of the system characteristics that are necessary to calculate the probability of system failure due to latency. It would be desirable to supply both a methodology for measuring latency, and an estimate of its effects in a typical avionics application. It is also desirable to measure the probability of failure of the software embedded in a flight critical piece of hardware using similar techniques to those used for measuring hardware latency. To achieve these objectives, simulations were constructed that were appropriate tor the type of system being tested (i.e., hardware or software). It was concluded that simulation is a viable means for validating both hardware and software and associating a reliability number with each. This is useful in determining the overall probability of system failure of an embedded processor unit, and improving both the code and the hardware where necessary to meet reliability requirements. The methodologies were proven using some simple programs and simple hardware models. Author

N90-25581# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Algorithms and Architecture.
A SURVEY OF CONCURRENT READERS AND WRITERS
Lefteris Kirousis (Patras Univ., Greece) and Evangelos Kranakis Sep. 1989 25 p

(Contract EC-3075)
(CWI-CS-R8936; ETN-90-96807) Copyright Avail: NTIS HC A03/MF A01

Implementations of concurrent high level objects from weaker lower level objects which are free from the usual control primitives, like mutual exclusion, test and set, etc. are considered. A survey of the most important recent results concerning such wait-free implementations of atomic multiwriter, multireader shared registers is given. Several algorithms for constructing atomic bits from safe bits, atomic multivalued shared variables from atomic bits, as well as atomic multireader and multiwriter shared variables from multivalued single writer, single reader shared variables, are presented. Several methods for proving the correctness of concurrent reader concurrent writer protocols are discussed.
ESA

N90-25582# General Accounting Office, Washington, DC. Information Management and Technology Div.
SPACE OPERATIONS: NASA EFFORTS TO DEVELOP AND DEPLOY ADVANCED SPACECRAFT COMPUTERS. REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS, COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, HOUSE OF REPRESENTATIVES
Samuel W. Bowlin et al Mar. 1989 43 p
(GAO/IMTEC-89-17; B-234056) Avail: NTIS HC A03/MF A01; also available from GAO, Gaithersburg, MD HC first five copies free, additional copies $2.00

NASA faces great challenges in building and deploying computers for its spacecraft. The performance capabilities of existing NASA spacecraft computers are discussed as well as ongoing NASA and Department of Defense programs to develop and deploy advanced spacecraft computers, and NASA's plans for space station computers. The time lag between the availability of computer technology on the ground and the use of that technology in space in 8 to 20 years, outdating computers even before they are launched into space. NASA is aware of this problem, but needs to test computers for reliability in harsh environments and select a computer early in the design process. Time lags also occur with unavoidable launching delays - of sometimes as much as several years. Shortening the time lag could significantly increase spacecraft capabilities for collecting scientific data and possibly decrease future mission costs. The report recommends that NASA's Administrator consider further strengthening the agency's ongoing activities by establishing an independent expert panel to determine if additional might be taken to shorten the process. Case studies of five missions are appended. J.P.S.

N90-25583* National Aeronautics and Space Administration. Pasadena Office, CA.
COMPUTER ACCESS SECURITY CODE SYSTEM Patent
Earl R. Collins, Jr., inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 15 May 1990 13 p Filed 5 Dec. 1988 Supersedes N89-29955 (27 - 24, p 3490)
(Contract NAS7-918)
(NASA-Case-NPO-17525-1-CU; US-Patent-4,926,481; US-Patent-Appl-SN-279630; US-Patent-Class-380-25; US-Patent-Class-380-45; US-Patent-Class-380-49; Int-Patent-Class-H02L-9/04) Avail: US Patent and Trademark Office CSCL 09B

A security code system for controlling access to computer and computer-controlled entry situations comprises a plurality of subsets of alpha-numeric characters disposed in random order in matrices of at least two dimensions forming theoretical rectangles, cubes, etc., such that when access is desired, at least one pair of previously unused character subsets not found in the same row or column of the matrix is chosen at random and transmitted by the computer. The proper response to gain access is transmittal of subsets which complete the rectangle, and/or a parallelepiped whose opposite corners were defined by first groups of code. Once used, subsets are not used again to absolutely defeat unauthorized access by eavesdropping, and the like.
Official Gazette of the U.S. Patent and Trademark Office

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N90-25584*# North Carolina State Univ., Raleigh. Dept. of Computer Science.
MULTI-VERSION SOFTWARE RELIABILITY THROUGH FAULT-AVOIDANCE AND FAULT-TOLERANCE Semiannual Technical Report, 1 Mar. - 31 Aug. 1989
Mladen A. Vouk and David F. McAllister 1 Sep. 1989 42 p
(Grant NAG1-983)
(NASA-CR-186502; NAS 1.26:186502) Avail: NTIS HC A03/MF A01 CSCL 09B

A number of experimental and theoretical issues associated with the practical use of multi-version software to provide run-time tolerance to software faults were investigated. A specialized tool was developed and evaluated for measuring testing coverage for a variety of metrics. The tool was used to collect information on the relationships between software faults and coverage provided by the testing process as measured by different metrics (including data flow metrics). Considerable correlation was found between coverage provided by some higher metrics and the elimination of faults in the code. Back-to-back testing was continued as an efficient mechanism for removal of un-correlated faults, and common-cause faults of variable span. Software reliability estimation methods was also continued based on non-random sampling, and the relationship between software reliability and code coverage provided through testing. New fault tolerance models were formulated. Simulation studies of the Acceptance Voting and Multi-stage Voting algorithms were finished and it was found that these two schemes for software fault tolerance are superior in many respects to some commonly used schemes. Particularly encouraging are the safety properties of the Acceptance testing scheme.
Author

N90-25585# Program Development Corp., White Plains, NY.
INTERACTIVE GRID GENERATION ON SMALL COMPUTERS Final Report, 1 Aug. 1989 - 31 Jan. 1990
Peter R. Eiseman 31 Jan. 1990 48 p
(Contract F49620-89-C-0096)
(AD-A221234; AFOSR-90-0505TR) Avail: NTIS HC A03/MF A01 CSCL 12/5

At the start of Phase 1, there were several 2-D single block codes and a basic mathematical structure for such codes. During the Phase 1 research, the feasibility for general 2-D multiblock code was firmly established. The mathematical structure of the control point form of algebraic grid generation (CCPF) was found to provide the essential theoretical framework for the codes and accordingly the necessary extensions of the CPF were of central importance. These were considered along with the important software techniques and the prototype code. Within the scope of software techniques, the elements of interactive graphics played a central role. The prototype code provided a good test of important ideas.
GRA

N90-25586*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
TOOLS FOR DISTRIBUTED APPLICATION MANAGEMENT
Keith Marzullo, Robert Cooper, Mark Wood, and Kenneth P. Birman Jun. 1990 32 p
(Grant NAG2-593)
(NASA-CR-186711; NAS 1.26:186711; TR-90-1136) Avail: NTIS HC A03/MF A01 CSCL 09B

Distributed application management consists of monitoring and controlling an application as it executes in a distributed environment. It encompasses such activities as configuration, initialization, performance monitoring, resource scheduling, and failure response. The Meta system (a collection of tools for constructing distributed application management software) is described. Meta provides the mechanism, while the programmer

specifies the policy for application management. The policy is manifested as a control program which is a soft real-time reactive program. The underlying application is instrumented with a variety of built-in and user-defined sensors and actuators. These define the interface between the control program and the application. The control program also has access to a database describing the structure of the application and the characteristics of its environment. Some of the more difficult problems for application management occur when preexisting, nondistributed programs are integrated into a distributed application for which they may not have been intended. Meta allows management functions to be retrofitted to such programs with a minimum of effort. Author

N90-25587*# Research Triangle Inst., Research Triangle Park, NC. Dept. of Software Research and Development.
GSC CONFIGURATION MANAGEMENT PLAN
B. Edward Withers May 1990 15 p
(Contract NAS1-17964)
(NASA-CR-182044; NAS 1.26:182044) Avail: NTIS HC A03/MF A01 CSCL 09B

The tools and methods used for the configuration management of the artifacts (including software and documentation) associated with the Guidance and Control Software (GCS) project are described. The GCS project is part of a software error studies research program. Three implementations of GCS are being produced in order to study the fundamental characteristics of the software failure process. The Code Management System (CMS) is used to track and retrieve versions of the documentation and software. Application of the CMS for this project is described and the numbering scheme is delineated for the versions of the project artifacts. Author

N90-25588*# Research Triangle Inst., Research Triangle Park, NC.
SOFTWARE QUALITY ASSURANCE PLAN FOR GCS
Stephen E. Duncan and Elizabeth K. Bailey May 1990 28 p
(Contract NAS1-17964)
(NASA-CR-182045; NAS 1.26:182045) Avail: NTIS HC A03/MF A01 CSCL 09B

The software quality assurance (SQA) function for the Guidance and Control Software (GCS) project which is part of a software error studies research program is described. The SQA plan outlines all of the procedures, controls, and audits to be carried out by the SQA organization to ensure adherence to the policies, procedures, and standards for the GCS project. Author

N90-25589*# Research Triangle Inst., Research Triangle Park, NC. Dept. of Software Research and Development.
GCS SUPPORT/DEVELOPMENT SYSTEM CONFIGURATION DOCUMENT
Douglas S. Lowman May 1990 18 p
(Contract NAS1-17964)
(NASA-CR-182046; NAS 1.26:182046; RTCA-DO-178) Avail: NTIS HC A03/MF A01 CSCL 09B

The software programming environment used in the development of Guidance and Control Software (GCS) implementations used in a software error studies experiment conducted by the Research Triangle Institute (RTI) and the NASA-Langley is described. The Radio Technical Commission for Aeronautics RTCA/DO-178A guidelines are fulfilled, and requirements for document number 9 in which the hardware, software, and processes used to develop and maintain the software for the GCS project are described. The software programming environment for GCS largely consists of tools that are included in Digital Equipment Corporations software layered product library or are a part of the VAX/VMS baseline system. Author

N90-25590*# Illinois Univ., Urbana-Champaign. Dept. of Computer Science.
QATT: A NATURAL LANGUAGE INTERFACE FOR QPE M.S. Thesis
Douglas Robert-Graha White Aug. 1989 50 p Sponsored in part by IBM and AT and T
(Grant NAG6-9137)
(UIUCDCS-R-89-1535; UILU-ENG-89-1754) Avail: NTIS HC A03/MF A01 CSCL 09B

QATT, a natural language interface developed for the Qualitative Process Engine (QPE) system is presented. The major goal was to evaluate the use of a preexisting natural language understanding system designed to be tailored for query processing in multiple domains of application. The other goal of QATT is to provide a comfortable environment in which to query envisionments in order to gain insight into the qualitative behavior of physical systems. It is shown that the use of the preexisting system made possible the development of a reasonably useful interface in a few months. Author

N90-25591# Lawrence Livermore National Lab., CA.
THE BASIS SYSTEM
Paul F. Dubois 16 May 1989 5 p Presented at the Cray User's Group Conference, Los Angeles, CA, 24-28 Apr. 1989 Submitted for publication
(Contract W-7405-eng-48)
(DE90-012077; UCRL-101124; CONF-8904210-8) Avail: NTIS HC A01/MF A01

The basis system is discussed. Basis is a program development system for scientific programs. It has been developed over the last five years at Lawrence Livermore National Laboratory (LLNL), where it is now used in about twenty major programming efforts. The Basis System includes two major components, a program development system and a run-time package. The run-time package provides the Basis Language interpreter, through which the user does input, output, plotting, and control of the program's subroutines and functions. Variables in the scientific packages are known to this interpreter, so that the user may arbitrarily print, plot, and calculate with, any major program variables. Also provided are facilities for dynamic memory management, terminal logs, error recovery, text-file i/o, and the attachment of non-Basis-developed packages. DOE

N90-25592# Nijmegen Univ. (Netherlands). Dept. of Informatics.
OUTLINE AND REALIZATION OF A POLYMORPHIC LANGUAGE EXTENSION FOR ELAN Thesis - Dortmund Univ. [ENTWURF UND REALISIERUNG EINER POLYMORPHEN SPRACHERWEITERUNG FUER ELAN]
Thomas Leuschner and Anja Niemann 21 Nov. 1989 292 p In GERMAN
(TR-89-23; ETN-90-96890) Avail: NTIS HC A13/MF A02

ELAN (educational language) is implemented in schools and universities as an introduction to programming. With the polymorphy, the description of algorithms can be abstract and easy to understand. Common useful programs become more reusable, methodical and shorter. Program analysis and manipulations are positively influenced. A packet and pretranslation mechanism is realized and a code generation is complemented for an ELAN compiler on a SUN processor. ESA

N90-25593*# Notre Dame Univ., IN. Dept. of Electrical and Computer Engineering.
MULTI-LEVEL TRELLIS CODED MODULATION AND MULTI-STAGE DECODING
Daniel J. Costello, Jr., Jiantian Wu, and Shu Lin (Hawaii Univ., Honolulu.) Jun. 1990 41 p Presented at the IEEE Information Theory Workshop, Eindhoven, Netherlands, Jun. 1990
(Grants NAG5-557; NSF NCR-89-03429)
(NASA-CR-186861; NAS 1.26:186861) Avail: NTIS HC A03/MF A01 CSCL 09B

Several constructions for multi-level trellis codes are presented and many codes with better performance than previously known codes are found. These codes provide a flexible trade-off between coding gain, decoding complexity, and decoding delay. New multi-level trellis coded modulation schemes using generalized set partitioning methods are developed for Quadrature Amplitude Modulation (QAM) and Phase Shift Keying (PSK) signal sets. New

rotationally invariant multi-level trellis codes which can be combined with differential encoding to resolve phase ambiguity are presented. Author

N90-25594*# Notre Dame Univ., IN. Dept. of Electrical and Computer Engineering.
NEW MULTI-LEVEL CODES OVER GF(q)
Jiantian Wu and Daniel J. Costello, Jr. Jul. 1990 24 p
(Grants NAG5-557; NSF NCR-89-03429)
(NASA-CR-186862; NAS 1.26:186862) Avail: NTIS HC A03/MF A01 CSCL 09B

Set partitioning to multi-dimensional signal spaces over GF(q), particularly GF sup q-1(q) and GF sup q (q), and show how to construct both multi-level block codes and multi-level trellis codes over GF(q). Two classes of multi-level (n, k, d) block codes over GF(q) with block length n, number of information symbols k, and minimum distance d sub min greater than or = d, are presented. These two classes of codes use Reed-Solomon codes as component codes. They can be easily decoded as block length q-1 Reed-Solomon codes or block length q or q + 1 extended Reed-Solomon codes using multi-stage decoding. Many of these codes have larger distances than comparable q-ary block codes, as component codes. Low rate q-ary convolutional codes, work error correcting convolutional codes, and binary-to-q-ary convolutional codes can also be used to construct multi-level trellis codes over GF(q) or binary-to-q-ary trellis codes, some of which have better performance than the above block codes. All of the new codes have simple decoding algorithms based on hard decision multi-stage decoding. Author

N90-25595# Lawrence Livermore National Lab., CA.
DEPTH BUFFER SHADOW ALGORITHMS
Charles W. Grant and Michael J. Allison 30 Jan. 1990 35 p
Presented at the ACM SIGGRAPH 1990, Dallas, TX, 6-10 Aug. 1990
(Contract W-7405-eng-48)
(DE90-012070; UCRL-102856; CONF-9008102-1) Avail: NTIS HC A03/MF A01

The depth buffer (also called z-buffer) visible surface algorithm is frequently used for shadow simulation. This shadow algorithm is very powerful, but it suffers from several problems such as aliasing and incorrect self-shadowing of simple surfaces. New algorithms are presented which solve these problems for most cases without much additional computation. A family of depth buffer shadow algorithms is defined. Three main improvements are presented. First, replacing the z-buffer with a p-buffer (plane buffer) gives a more accurate representation of the visible surface across a pixel. Second, storing two surface in the shadow buffer the closest and the second surfaces to the light source, and averaging them to form an intermediate surface yields a much better defined illumination test. Third, considering the values of adjacent pixels in the shadow buffer helps to reduce some aliasing artifacts. These techniques preserve all the desirable properties of the depth buffer visible surface algorithm while yielding more accurate shadows. DOE

N90-25596# Societe Bertin et Cie, Plaisir (France).
COMPUTER-AIDED DESIGN OF ADVANCED CONTROL ALGORITHMS FOR INDUSTRIAL ROBOTICS: AN OVERVIEW OF ESPRIT PROJECT SACODY
Jean-Luc Faillot 1989 27 p Submitted for publication
Sponsored by Commission of the European Communities
(Rept-81-DT-89-47; ETN-90-97017) Avail: NTIS HC A03/MF A01

Objectives and achievements of the project SACODY, which focuses on the development of techniques and tools which are necessary for the implementation of advanced controls for high speed industrial robots, are outlined. Specifically, all mechanical manipulators exhibit at high speed coupled dynamic flexions and torsions which limit their performance and can be reduced or suppressed by appropriate control actions. Issues being addressed in project SACODY deal with the development of modeling identification and control methods and software, constituting a complete set of tools needed to design adaptive new control actions. The performances achieved by new control are tested on laboratory models and will be demonstrated at the end of the project on an industrial robot. Major outputs of the project are techniques, their implementation into computer aided design software, and their implementation in a robot controller for test on an industrial robot. ESA

N90-25597 Politecnico di Milano (Italy). Dipartimento di Elettronica.
RANDOM PSEUDO-POLYNOMIAL ALGORITHMS IN COMBINATORIAL PROGRAMMING
G. Galbiati (Pavia Univ., Italy) and F. Maffioli 1989 21 p
Sponsored in part by Italian Ministry of Public Education and Italian Ministry of University and Scientific Research
(Grant NATO-RG-85-0240)
(Rept-89-067; ETN-90-97029) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Recent results on random pseudo polynomial algorithms for weighted combinatorial problems are surveyed. These problems require the computation either of a solution of exact value, or of an optimum solution, or of an entire set of possible solution values (the image) of the problem. Questions concerning images are remarked for future research. ESA

N90-25598# Norwegian Defence Research Establishment, Kjeller.
MEXP: A PROGRAMMING TOOL FOR THE CESAR PROGRAMMABLE SYSTOLIC ARRAY MULTIPROCESSOR
Hans-Petter Mellerud 28 Dec. 1989 155 p
(FFI-89/7020; ISSN-0802-2437; ETN-90-97033) Avail: NTIS HC A08/MF A01

MEXP is a software tool used to ease programming the CESAR systolic array multiprocessor. The CESAR system is described followed by fundamental strategies in the realization of MEXP. These strategies include problem solving methods, shortest path algorithms, and backtracking issues. An overview of MEXP is given. The implementation including a short description of the twenty one modules and data structures used is discussed. Methods for ordering placement of operations, determining search patterns, and finding available data paths between computing elements on the systolic array are presented. The use of MEXP is covered. An evaluation of MEXP performance is given for a number of real life problems together with a description of potential future enhancements. ESA

N90-25599# Norwegian Defence Research Establishment, Kjeller.
CESAR SEQUENCER
Bard Tokerud 22 Dec. 1989 180 p
(FFI-89/7021; ISSN-0802-2437; ETN-90-97034) Avail: NTIS HC A09/MF A01

Functional documentation of the sequencer is given and the hardware controller in CESAR outlined. The sequencer is dedicated to provide the control signals for the SVOP (Speedy Vector Oriented Processor) operations. The main characteristics of the sequencer are listed. A functional description is provided. The user interface, including test facilities, are described. A circuit description and timing specification is given. The printed circuit board is described. Graphics, flow diagrams and coding are illustrated. ESA

N90-25600# Oxford Univ. (England). Dept. of Engineering Science.
A TOPOLOGICAL IMAGE MATCHER
Margaret M. Fleck 1989 43 p
(OUEL-1798/89; ETN-90-97049) Avail: NTIS HC A03/MF A01

Computer vision tasks to determine whether two patches are similar or dissimilar are addressed. The assignation of a topological structure, induced by boundary locations, to images is shown. It is proposed that this structure be preserved locally during the matching process. The new matcher offers two advantages for stereo matching: support neighborhoods about each cell are constructed dynamically, enabling the matcher to correctly

reconstruct sharp changes in disparity; its robust match evaluations allow it to use larger search areas than previous algorithms. These improvements, plus novel search and interpolation techniques, allow the new stereo matcher to achieve performance comparable to that of humans, particularly the ability to correct vertical misalignments in stereo pairs. ESA

N90-25601# Royal Signals and Radar Establishment, Malvern (England).
THE KNUTH-BENDIX COMPLETION ALGORITHM AND ITS SPECIFICATION IN Z
A. Smith Sep. 1989 29 p
(RSRE-Memo-4323; BR112412; ETN-90-97052) Copyright
Avail: NTIS HC A03/MF A01

Proving that something is a consequence of a set of axioms can be very difficult. The Knuth-Bendix completion algorithm attempts to automate this process when the axioms are equations. The algorithm is bound up in the area of term rewriting. The theory of term rewriting is introduced, followed by an overview of the algorithm. A formal specification of the algorithm is given using the language Z. ESA

N90-25602*# Pittsburgh Univ., PA.
TRANSIENT FINITE ELEMENT COMPUTATIONS ON THE TRANSPUTER SYSTEM
Patrick Smolinski Jan. 1990 38 p
(Grant NAG3-829)
(NASA-CR-186632; NAS 1.26:186632) Avail: NTIS HC A03/MF A01 CSCL 09B

The solution of transient finite element problems on the Transputer system of parallel processors was studied. The central difference time integration rule was used so that no equation solving was necessary. Also investigated was subcycling time integration which uses different time steps in different subdomains of the finite element mesh. A 1-D bar problem was analyzed using the parallel time integration algorithm. This involves subdividing the bar into subproblems which are assigned to different processors. Results show that the significant speed-up can be obtained through parallel processing. Also subcycling can give an additional speed-up in certain classes of problems. A 2-D problem was also examined to evaluate the effect of the communication to computation ratio on solution time. Author

N90-25076# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
A CAX SUCCESS STORY
Ernst Grill, Johann Flittner, and Walter Rausch *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 9-14 (For primary document see N90-25075 19-01)
(MBB-FW-52/S/PUB-382) Avail: NTIS HC A15/MF A02

N90-25078# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
DEVELOPMENT AND APPLICATION OF AN OPTIMIZATION PROCEDURE FOR SPACE AND AIRCRAFT STRUCTURES
Guenter Kneppe, Wolfgang Hartzheim, and Georg Zimmermann *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 23-28 Presented at GAMM-Seminar on Discretization Methods and Structural Optimization, 1989 (For primary document see N90-25075 19-01)
(MBB-FW-522/S/PUB-383) Avail: NTIS HC A15/MF A02

N90-25098# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Wehrtechnik.
REALTIME SIMULATION AT MBB TODAY AND FUTURE ASPECTS
Thomas Kuestner *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 293-300 Presented at SIMSIG 89, San Francisco, CA, 22-28 May 1989 (For primary document see N90-25075 19-01)
(MBB-UA-1134/89-PUB) Avail: NTIS HC A15/MF A02

N90-25505*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MOBILE TRANSPORTER PATH PLANNING
Paul Baffes and Lui Wang *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 51-59 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25511*# Ford Aerospace and Communications Corp., Sunnyvale, CA. Artificial Intelligence Group.
STARPLAN: A MODEL-BASED DIAGNOSTIC SYSTEM FOR SPACECRAFT
Dennis Heher and Paul Pownall *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 117-121 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25515*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
CREW CHIEF: A COMPUTER GRAPHICS SIMULATION OF AN AIRCRAFT MAINTENANCE TECHNICIAN
Nilss M. Aume *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 139-141 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25516*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
MODELING STRENGTH DATA FOR CREW CHIEF
Joe W. McDaniel *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 143-148 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25517*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE USE OF PLAID IN THE SPACE STATION FREEDOM VIEWING ANALYSIS
Frances E. Mount and Sandra D. McKee (Lockheed Engineering and Sciences Co., Houston, TX.) *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 149-153 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25533*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CLEAR: AUTOMATING CONTROL CENTERS WITH EXPERT SYSTEM TECHNOLOGY
Peter M. Hughes *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 289-293 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25534*# Mitre Corp., Houston, TX.
PROCESS AND INFORMATION INTEGRATION VIA HYPERMEDIA
David G. Hammen, Daniel L. LaBasse, and Robert M. Myers *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 295-298 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25535*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AN APPROACH TO A REAL-TIME DISTRIBUTION SYSTEM
Frank P. Kittle, Jr., Eddie J. Paddock, Tony Pocklington (McDonnell-Douglas Corp., Houston, TX.), and Lui Wang *In its* Third Annual Workshop on Space Operations Automation and

Robotics (SOAR 1989) Mar. 1990 p 299-303 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25541*# Illinois Univ., Urbana-Champaign. Dept. of Mechanical and Industrial Engineering.
SHAPA: AN INTERACTIVE SOFTWARE TOOL FOR PROTOCOL ANALYSIS APPLIED TO AIRCREW COMMUNICATIONS AND WORKLOAD
Jeffrey M. James, Penelope M. Sanderson, and Karen S. Seidler *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 347-352 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25547*# Decision-Science Applications, Inc., Arlington, VA.
AUTOMATED CONTROL OF HIERARCHICAL SYSTEMS USING VALUE-DRIVEN METHODS
George E. Pugh and Thomas E. Burke *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 415-422 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25571*# International Business Machines Corp., Houston, TX. Systems Integration Div.
ACES: SPACE SHUTTLE FLIGHT SOFTWARE ANALYSIS EXPERT SYSTEM
R. Scott Satterwhite *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 633-636 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25574*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PROCESS AND REPRESENTATION IN GRAPHICAL DISPLAYS
Douglas J. Gillan, Robert Lewis (Rice Univ., Houston, TX.), and Marianne Rudisill *In its* Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 661-665 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N90-25603*# Cornell Univ., Ithaca, NY.
EXPLOITING REPLICATION IN DISTRIBUTED SYSTEMS
Kenneth P. Birman and T. A. Joseph [1989] 50 p
(Grant NAG2-593)
(NASA-CR-186410; NAS 1.26:186410) Avail: NTIS HC A03/MF A01 CSCL 09B

Techniques are examined for replicating data and execution in directly distributed systems: systems in which multiple processes interact directly with one another while continuously respecting constraints on their joint behavior. Directly distributed systems are often required to solve difficult problems, ranging from management of replicated data to dynamic reconfiguration in response to failures. It is shown that these problems reduce to more primitive, order-based consistency problems, which can be solved using primitives such as the reliable broadcast protocols. Moreover, given a system that implements reliable broadcast primitives, a flexible set of high-level tools can be provided for building a wide variety of directly distributed application programs. Author

N90-25604*# Toledo Univ., OH. Dept. of Computer Science and Engineering.
MODELING AND SYNTHESIS OF MULTICOMPUTER INTERCONNECTION NETWORKS
Hilda M. Standley and D. Steve Auxter 1990 10 p
(Grant NAG3-699)
(NASA-CR-186619; NAS 1.26:186619) Avail: NTIS HC A02/MF A01 CSCL 09B

The type of interconnection network employed has a profound effect on the performance of a multicomputer and multiprocessor design. Adequate models are needed to aid in the design and development of interconnection networks. A novel modeling approach using statistical and optimization techniques is described. This method represents an attempt to compare diverse interconnection network designs in a way that allows not only the best of existing designs to be identified but to suggest other, perhaps hybrid, networks that may offer better performance. Stepwise linear regression is used to develop a polynomial surface representation of performance in a (k+1) space with a total of k quantitative and qualitative independent variables describing graph-theoretic characteristics such as size, average degree, diameter, radius, girth, node-connectivity, edge-connectivity, minimum dominating set size, and maximum number of prime node and edge cutsets. Dependent variables used to measure performance are average message delay and the ratio of message completion rate to network connection cost. Response Surface Methodology (RSM) optimizes a response variable from a polynomial function of several independent variables. Steepest ascent path may also be used to approach optimum points.
Author

N90-25605# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
ON THE DESIGN OF A CONCURRENT IMAGE ANALYSIS SYSTEM
Judson P. Jones 1990 7 p Presented at the ISRAM 1990: International Symposium on Robotics and Automation, Vancouver, British Columbia, 18-20 Jul. 1990
(Contract DE-AC05-84OR-21400)
(DE90-011388; CONF-900780-4) Avail: NTIS HC A02/MF A01

Because programming parallel computers is challenging, their use has been limited. To make the technology more accessible it is necessary to develop programming environments which hide the details. An environment for image analysis on concurrent computers is described which provides fundamental services for parallelism. The system is organized in a tripartite abstraction hierarchy. The topmost level can be programmed as though it were an ordinary sequential computer. Distributed memory and message passing appear only at lower levels. An operational taxonomy consisting of mathematical transformations, memory management, domain decomposition, and input/output facilities for relevant data structures form the nucleus of the environment. A collection of applications are enumerated; advantages and drawbacks are discussed. DOE

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N90-25606# University of Southern California, Marina del Rey. Information Sciences Inst.
A RESEARCH PROGRAM IN COMPUTER TECHNOLOGY Annual Technical Report, Jul. 1985 - Jun. 1986
Aug. 1989 150 p
(Contract MDA903-81-C-0335)
(AD-A221184; ISI/SR-87-178) Avail: NTIS HC A07/MF A01 CSCL 12/5

This report summarizes the research performed by USC/Information Sciences Institute from July 1, 1985, to June 30, 1986, for the Defense Advanced Research Projects Agency. The research is focused on the development of computer science and technology, which is expected to have a high DoD/military impact. Common LISP Framework; Explainable Expert Systems; Formalized System Development; Command and Control Communications;

Advanced Very Large Scale Integration (VLSI); KITSERV - VLSI Kit Design Service; Empirically Valid Knowledge Representation; Text Generation for Strategic Computing; Commercial Mail; Computer Research Support; DARPA Headquarters Support Center; Exportable Workstation Systems; New Computing Environment; Strategic Computing - Development Systems; and Strategic C3 System Experiment Support are among the topics covered. GRA

N90-25607*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NEUROMORPHIC LEARNING OF CONTINUOUS-VALUED MAPPINGS FROM NOISE-CORRUPTED DATA. APPLICATION TO REAL-TIME ADAPTIVE CONTROL
Terry Troudet (Sverdrup Technology, Inc., Cleveland, OH.) and Walter C. Merrill Washington May 1990 25 p
(NASA-TM-4176; E-4967; NAS 1.15:4176) Avail: NTIS HC A03/MF A01 CSCL 09B

The ability of feed-forward neural network architectures to learn continuous valued mappings in the presence of noise was demonstrated in relation to parameter identification and real-time adaptive control applications. An error function was introduced to help optimize parameter values such as number of training iterations, observation time, sampling rate, and scaling of the control signal. The learning performance depended essentially on the degree of embodiment of the control law in the training data set and on the degree of uniformity of the probability distribution function of the data that are presented to the net during sequence. When a control law was corrupted by noise, the fluctuations of the training data biased the probability distribution function of the training data sequence. Only if the noise contamination is minimized and the degree of embodiment of the control law is maximized, can a neural net develop a good representation of the mapping and be used as a neurocontroller. A multilayer net was trained with back-error-propagation to control a cart-pole system for linear and nonlinear control laws in the presence of data processing noise and measurement noise. The neurocontroller exhibited noise-filtering properties and was found to operate more smoothly than the teacher in the presence of measurement noise. Author

N90-25608*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
A CONTROL PROBLEM FOR BURGERS' EQUATION WITH BOUNDED INPUT/OUTPUT Final Report
John A. Burns and Sungkwon Kang (Virginia Polytechnic Inst. and State Univ., Blacksburg.) Jun. 1990 38 p Submitted for publication
(Contracts NAS1-18605; F49620-87-C-0116; N00014-88-K-0721; AF-AFOSR-0001-89)
(NASA-CR-182062; NAS 1.26:182062; ICASE-90-45) Avail: NTIS HC A03/MF A01 CSCL 09B

A stabilization problem for Burgers' equation is considered. Using linearization, various controllers are constructed which minimize certain weighted energy functionals. These controllers produce the desired degree of stability for the closed-loop nonlinear system. A numerical scheme for computing the feedback gain functional is developed and several numerical experiments are performed to show the theoretical results. Author

N90-25609*# ST Systems Corp., Lanham, MD.
ADAPTIVE TRACKING FOR COMPLEX SYSTEMS USING REDUCED-ORDER MODELS
Craig R. Carignan 1990 20 p
(Contract NAS5-30440)
(NASA-CR-183464; NAS 1.26:183464) Avail: NTIS HC A03/MF A01 CSCL 09B

Reduced-order models are considered in the context of parameter adaptive controllers for tracking workspace trajectories. A dual-arm manipulation task is used to illustrate the methodology and provide simulation results. A parameter adaptive controller is designed to track the desired position trajectory of a payload using a four-parameter model instead of a full-order, nine-parameter model. Several simulations with different payload-to-arm mass ratios are used to illustrate the capabilities of the reduced-order model in tracking the desired trajectory. Author

N90-25610*# Catholic Univ. of America, Washington, DC. Dept. of Electrical Engineering.
TRAJECTORY PLANNING AND CONTROL OF A 6 DOF MANIPULATOR WITH STEWART PLATFORM-BASED MECHANISM Report, 1 Feb. - 31 Jul. 1990
Charles C. Nguyen and Sami Antrazi Jul. 1990 12 p
(Grant NAG5-780)
(NASA-CR-186813; NAS 1.26:186813) Avail: NTIS HC A03/MF A01 CSCL 09B

The trajectory planning and control was studied of a robot manipulator that has 6 degrees of freedom and was designed based on the mechanism of the Stewart Platform. First the main components of the manipulator is described along with its operation. The solutions are briefly prescribed for the forward and inverse kinematics of the manipulator. After that, two trajectory planning schemes are developed using the manipulator inverse kinematics to track straight lines and circular paths. Finally experiments conducted to study the performance of the developed planning schemes in tracking a straight line and a circle are presented and discussed. Author

N90-25611*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OPERATIONS MISSION PLANNER Final Report
Eric Biefeld and Lynne Cooper 15 Mar. 1990 156 p Original contains color illustrations
(Contract NAS7-918)
(NASA-CR-186846; NAS 1.26:186846; JPL-Publ-90-16) Avail: NTIS HC A08/MF A01; 3 functional color pages CSCL 09B

The findings are documented of the OMP research task, which investigated the applicability of artificial intelligence (AI) technology in support of automated scheduling. The goals of the effort are summarized and the technical accomplishments are highlighted. The OMP task succeeded in identifying how AI technology could be applied and demonstrated an AI-based automated scheduling approach through the OMP prototypes. Author

N90-25612# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
ON CONDITIONS FOR THE DEVELOPMENT OF STABLE DISCRETE-TIME SLIDING MODE CONTROL SYSTEMS
S. K. Spurgeon Apr. 1990 14 p
(MATHS-Rept-A-124; ETN-90-97047) Avail: NTIS HC A03/MF A01

Proposed necessary and sufficient conditions for the stability of discrete-time sliding mode control systems were recently presented in the literature. Here, it is demonstrated that the proposed conditions are sufficient but not necessary, and a new necessary condition is suggested. A numerical example is used to demonstrate the results. ESA

N90-25613# Royal Signals and Radar Establishment, Malvern (England).
MULTI-MICROPROCESSOR CONTROL OF A PRECISION PAN AND TILT HEAD
E. C. E. Charlwood and C. J. Turner Jan. 1989 23 p
(RSRE-Memo-4252; BR112415; ETN-90-97051) Copyright Avail: NTIS HC A03/MF A01

A microprocessor system used to control a heavy duty precision pan and tilt head is studied. A multiprocessor architecture was used to provide interactive control of the head and a capability to gather and track targets automatically with a thermal imager as the tracking sensor. The time taken to gather the target and establish a stable track was demonstrated to be of the order of 0.25 s against a variety of aircraft targets with crossing rates up to 100 mR/s. ESA

N90-25614# Sheffield Univ. (England). Dept. of Control Engineering.
A PARALLEL NEWTON-EULER FORMULATION FOR FAST DYNAMIC SIMULATION OF ROBOT MANIPULATORS
A. Y. Zomaya and Alan S. Morris Jul. 1989 27 p
(RR-368; ETN-90-97111) Avail: NTIS HC A03/MF A01

A solution of the robot arm control by employment of a parallel processing approach is presented. The dynamics are computed by using a semi-customized Newton-Euler formulation. The algorithm is distributed over a highly coupled multiple-instruction multiple-data stream computer architecture. The computer system is constructed from general purpose VLSI (Very Large Scale Integration) building blocks called the Transputer (trademark). The cost effectiveness and speed of the scheme is demonstrated by a case study. The communication issues between the different processors are discussed. Speed up results are included to show the superiority and advantages of the parallel approach. ESA

N90-25615# Sheffield Univ. (England). Dept. of Control Engineering.
MINIMUM VARIANCE CONTROL OF NONLINEAR SYSTEMS
S. A. Billings and K. R. Sales (Unilever Research, Merseyside, England) Aug. 1990 7 p Presented at IEEE Colloquium on Adaptative Algorithms for Signal Processing and Control, Edinburgh, England, 13 Sep. 1989
(RR-369; ETN-90-97112) Avail: NTIS HC A02/MF A01

A minimum-variance self-tunning controller with a nonlinear difference equation structure is described. The adaptiveness is provided by an extended least squares estimation algorithm. Performance analysis is discussed in terms of a cumulative loss function and high order correlation functions. Such functions were derived for use in conjunction with nonlinear ARMAX models. Simulation results using the model of a practical process are described. ESA

N90-25616# Sheffield Univ. (England). Dept. of Control Engineering.
NON-LINEAR SYSTEMS IDENTIFICATION USING NEURAL NETWORKS
S. Chen, S. A. Billings, and P. M. Grant (Edinburgh Univ., Scotland) Aug. 1989 31 p Sponsored by United Kingdom Science and Engineering Research Council
(RR-370; ETN-90-97113) Avail: NTIS HC A03/MF A01

Multilayered neural networks offer an alternative for modeling complex nonlinear systems. The identification of discrete-time nonlinear systems is investigated using neural networks with a single hidden layer. New parameter estimation algorithms are derived for the neural network model. They are based on a prediction error formulation and the application to both simulated and real data is included to demonstrate the effectiveness of the neural network approach. ESA

N90-25617# Sheffield Univ. (England). Dept. of Control Engineering.
A PARALLEL RECURSIVE PREDICTION ERROR ALGORITHM FOR TRAINING LAYERED NEURAL NETWORKS
S. Chen, C. F. N. Cowan, S. A. Billings (Edinburgh Univ., Scotland), and P. M. Grant Oct. 1989 22 p Sponsored by United Kingdom Science and Engineering Research Council
(RR-373; ETN-90-97115) Avail: NTIS HC A03/MF A01

A recursive prediction error algorithm is derived for the training of feedforward layered neural networks. The algorithm enables the weights in each neuron of the network to be updated. Better convergence properties than the classical back propagation algorithm are obtained. The relationship between this parallel algorithm and other existing learning algorithms is discussed. Examples are taken from the fields of communication channel equalization. Nonlinear systems modeling is used to demonstrate the performance of the new algorithm compared with the back propagation routine. ESA

N90-25618# Sheffield Univ. (England). Robotics Research Group.
ADAPTIVE ROBOT CONTROL USING ARTIFICIAL NEURAL NETWORKS: AN APPLICATION IN THE THEORY OF COGNITION
Ali M. S. Zalzala and Alan S. Morris Oct. 1989 50 p
(RR-374; ETN-90-97116) Avail: NTIS HC A03/MF A01

A feasible solution for the fast realtime control of robot manipulators by adapting certain concepts of neural networks is discussed. An adaptive controller is presented which solves for the highly coupled dynamic equations of motion. A representation of the Lagrange-Euler equations is adapted for this purpose. The neural controller is designed on a multilayered network, in which the adaptation for environmental changes could be accommodated via the back-propagation of errors throughout the network. The proposed controller is capable of adapting to changes in the robot model parameters in realtime applications. The use of distributed parallel processing concepts greatly simplifies the computations required within each control cycle. Simulation results are reported. ESA

N90-25619# Sheffield Univ. (England). Dept. of Control Engineering.
NONLINEAR SYSTEMS, THE LIE SERIES, AND THE LEFT SHIFT OPERATOR: APPLICATION TO NONLINEAR OPTIMAL CONTROL
S. P. Banks and N. Iddir May 1989 19 p
(RR-376; ETN-90-97118) Avail: NTIS HC A03/MF A01

A new representation of nonlinear systems involving the Lie series is obtained and applied to nonlinear optimal control. A brief introduction to Lie series, with two examples to illustrate the technique are given. A connection between general nonlinear systems and the left-shift operator is established and generalized to nonlinear control systems. The method is applied to obtain an explicit solution to the linear analytic quadratic optimal control problem. ESA

N90-25620# Sheffield Univ. (England). Dept. of Control Engineering.
A COMPARISON OF THE BACKPROPAGATION AND RECURSIVE PREDICTION ERROR ALGORITHMS FOR TRAINING NEURAL NETWORKS
S. A. Billings, H. B. Jamaluddin, and S. Chen (Edinburgh Univ., Scotland) Jan. 1990 38 p
(RR-379; ETN-90-97121) Avail: NTIS HC A03/MF A01

The use of neural networks to model nonlinear systems is investigated. A recursive prediction error routine is compared with the backpropagation method of training neural networks. Results based on simulated systems, the prediction of Canadian Lynx data, and the modeling of an automotive diesel engine are obtained. Results indicate that the recursive prediction error algorithm is superior to backpropagation. ESA

N90-25504*# Air Force Systems Command, Andrews AFB, MD. Artificial Intelligence Technology Development.
ARTIFICIAL INTELLIGENCE WITHIN AFSC
Mark A. Gersh *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 13-46 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25524*# Stanford Univ., CA.
MONITORING AND CONTROL OF SPACECRAFT SYSTEMS USING PROCEDURAL REASONING
Michael P. Georgeff and Francois Felix Ingrand (SRI International Corp., Menlo Park, CA.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 209-217 Sponsored in part by Institut National de Recherche en Informatique et en Automatique (INRIA) (For primary document see N90-25503 19-59)

(Contract NAS2-12521)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25525*# Aerospace Corp., Los Angeles, CA. Computer Science Lab.
KNOWLEDGE REPRESENTATION TO SUPPORT REASONING BASED ON MULTIPLE MODELS
April Gillam, Jorge P. Seidel, and Alice C. Parker (University of Southern California, Los Angeles.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 219-221 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25532*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ARTIFICIAL INTELLIGENCE FOR MULTI-MISSION PLANETARY OPERATIONS
David J. Atkinson, Denise L. Lawson, and Mark L. James *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 281-287 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25536*# Pittsburgh Univ., PA. Dept. of Information Science.
A COMPARISON OF TWO NEURAL NETWORK SCHEMES FOR NAVIGATION
Paul Munro *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 305-310 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25546*# Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.
A TASK CONTROL ARCHITECTURE FOR AUTONOMOUS ROBOTS
Reid Simmons and Tom Mitchell *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 409-414 (For primary document see N90-25503 19-59)
(Grant NAGw-1175)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25548*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PLANNING FOR EXECUTION MONITORING ON A PLANETARY ROVER
Erann Gat, R. James Firby, and David P. Miller *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 423-427 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25552*# Kellogg (M. W.) Co., Houston, TX.
NUMERICAL APPROACH OF COLLISION AVOIDANCE AND OPTIMAL CONTROL ON ROBOTIC MANIPULATORS
Jyhshing Jack Wang *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 455-464 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25561*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
BEHAVIORAL NETWORKS AS A MODEL FOR INTELLIGENT AGENTS
Nancy E. Sliwa *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 537-542 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25563*# Michigan Univ., Ann Arbor. Artificial Intelligence Lab.
THE APPLICATION OF NASREM TO REMOTE ROBOT CONTROL
Michael W. Walker, Joe Dionise, and Al Dobryden *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 551-557 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25567*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FUNCTIONAL DESCRIPTION OF A COMMAND AND CONTROL LANGUAGE TUTOR
David R. Elke, Thomas L. Seamster (Carlow Associates, Inc., Fairfax, VA.), and Walter Truszkowski *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 585-592 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25568*# Air Force Human Resources Lab., Brooks AFB, TX. Manpower and Personnel Div.
SUCCESS IN TUTORING ELECTRONIC TROUBLESHOOTING
Ellen M. Parker *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 593-603 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25569*# BDM Corp., Huntsville, AL.
A MODEL FOR A KNOWLEDGE-BASED SYSTEM'S LIFE CYCLE
Peter A. Kiss *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 605-610 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25570*# Air Force Logistics Command, Wright-Patterson AFB, OH.
KNOWLEDGE-BASED SYSTEMS (KBS) DEVELOPMENT STANDARDS: A MAINTENANCE PERSPECTIVE
John Brill *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 611-630 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25573*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A LABORATORY BREADBOARD SYSTEM FOR DUAL-ARM TELEOPERATION
A. K. Bejczy, Z. Szakaly, and W. S. Kim *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 649-660 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25575*# Martin Marietta Aerospace, Denver, CO. Astronautics Group.
EVALUATION OF OFF-ROAD TERRAIN WITH STATIC STEREO AND MONOSCOPIC DISPLAYS
John P. Yorchak and Craig S. Hartley *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 671-678 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 09B

N90-25577*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EXTENSIONS OF ALGEBRAIC IMAGE OPERATORS: AN APPROACH TO MODEL-BASED VISION
Bao-Ting Lerner and Michael V. Morelli (Fairleigh Dickinson Univ., Teaneck, NJ.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 687-695 (For primary document see N90-25503 19-59)
(NASA Order S-92580-D)
Avail: NTIS HC A99/MF A04 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N90-25621# Cimflex Teknowledge Corp., Palo Alto, CA.
INTELLIGENT REAL-TIME PROBLEM SOLVING Final Report, 15 Sep. - 14 Dec. 1989
Lee D. Erman, ed. Jan. 1990 190 p Workshop held in Santa Cruz, CA, 6-7 Nov. 1989
(Contract F49620-89-C-0129)
(AD-A220357; AFOSR-90-0323TR) Avail: NTIS HC A09/MF A01 CSCL 12/9

An initiative to stimulate the development of a national basic research focus on IRTPS was sponsored. The results of that workshop and the work leading up to it are summarized. GRA

N90-25622 Toronto Univ. (Ontario). Inst. for Aerospace Studies.
ADAPTIVE NODE MOVEMENT IN FINITE-DIFFERENCE SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS TO GASDYNAMICS, PART 1 Thesis
Donald Frederick Hawken Feb. 1990 129 p Sponsored by Natural Sciences and Engineering Research Council of Canada
(UTIAS-333-Pt-1; ISSN-0082-5255) Copyright Avail: Issuing Activity

Two adaptive numerical methods of solving partial differential equations are studied in detail. A review of the adaptive-method literature is included. The methods reviewed involve the adaptive movement of nodes, so as to obtain a low level of solution truncation error while minimizing the number of nodes used in the calculation. Such methods are applicable to the solution of nonstationary flow problems that contain moving regions of rapid change in the flow variables, surrounded by regions of relatively smooth variation. Flows with shock waves, contact surfaces, slip streams, phase change interfaces, and boundary layers can be modeled with great precision by these methods. Significant economies of execution can be attained if nodes are moved so that they remain concentrated in regions of rapid variation of the flow variables. One of the reviewed methods, the Moving Finite Element (MFE) method originally introduced by Miller and Miller, was implemented and is compared to a second method, called the Moving Finite Difference (MFD) method, which was developed for this thesis. Both methods solve simultaneously for the flow variables and node locations at each time-step. These adaptive methods move the nodes so as to minimize an error measure that contains a function of the time derivatives of the solution. The error measure is manipulated to obtain a matrix equation for node velocities. Author

N90-25623 Toronto Univ. (Ontario). Inst. for Aerospace Studies.
ADAPTIVE NODE MOVEMENT IN FINITE-DIFFERENCE SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS TO GASDYNAMICS, PART 2 Thesis
Donald Frederick Hawken Feb. 1990 231 p Sponsored by Natural Sciences and Engineering Research Council of Canada
(UTIAS-333-Pt-2; ISSN-0082-5255) Copyright Avail: Issuing Activity

An in-depth study is presented of two adaptive numerical methods of solving partial differential equations. A review of the adaptive-method literature is included. The methods reviewed involve the adaptive movement of nodes, so as to obtain a low level of solution truncation error while minimizing the number of nodes used in the calculation. Both methods make use of penalty functions to prevent node crossing. The penalty functions result in extra terms in the matrix equation that promote node repulsion and that become large when node separation becomes small. Extensive work applying the Moving Finite Element (MFE) and Moving Finite Difference (MFD) methods to one-dimensional gasdynamics problems has been performed. The test problems consist of Burgers' equation, ideal viscid planar flow of gas within a shock-tube, analogous spherically symmetric flow of gas resulting from an implosion/explosion process, and propagation of a shock wave or rarefaction wave in a duct with an area change. The MFD method typically executes with at least twice the speed of the MFE method, and the solution exhibits comparable or greater quality. A stability analysis of the solution of Burgers' equation was performed. The results of the analysis imply an increase in stability if adaptive methods compute node-velocities that keep the nodes moving in step with the regions of rapid change in the flow variables. Author

N90-25624# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
SOME OBSERVATIONS FOR THE PIGEON HOLE PRINCIPLE
F. J. Brandenburg, J. vanLeeuwen, and R. B. Tan (Oklahoma Coll. of Liberal Arts, Chickasha.) Dec. 1988 9 p
(RUU-CS-88-39; ETN-90-96860) Avail: NTIS HC A02/MF A01

Several elementary combinatorial facts and complexity results related to the pigeon hole principle are proved. The pigeon hole principle is described. Applications of the principle in mathematical contexts are discussed. Additional combinatorial facts, when n plus one (or more) items are divided over n boxes, which may serve as classroom illustrations or exercises used in discussion of the pigeon hole principle, are reviewed. Some of the aspects of the distribution of N items over n boxes are discussed. Some complexity results for distributions over two sets of distinct boxes are described. ESA

N90-25625# Wichita State Univ., KS. Inst. for Aviation Research.
APPLYING FORMAL MODELS AND PROOFS TO THE VERIFICATION OF DISTRIBUTED SYSTEMS
James E. Tomayko and Eugeniusz Eberbach (University Coll., London, England) Feb. 1989 14 p
(IAR-89-7) Avail: NTIS HC A03/MF A01

How software engineers can use formal models and proofs of correctness in verifying distributed systems is explored. A typical distributed architecture is described, and then used as an example of the application of formal methods at different levels of abstraction. Author

N90-25626# Los Alamos National Lab., NM. Theoretical Div.
AUTOMATED ANGULAR MOMENTUM RECOUPLING ALGEBRA
H. T. Williams (Washington and Lee Univ., Lexington, VA.) and Richard R. Silbar 1990 7 p Presented at the Lyon Workshop, Lyon, France, 19-24 Mar. 1990 Submitted for publication
(Contract W-7405-eng-36)
(DE90-011988; LA-UR-90-1933; CONF-9003167-1) Avail: NTIS HC A02/MF A01

A code, RACAH, for algebraic solution of angular momentum recoupling problems was described. The general problem is to find an optimal path from one binary tree (representing the angular momentum coupling scheme for the reduced matrix element) to another (representing the sub-integrals and spin sums to be done). RACAH is implemented on a MS-DOS microcomputer, using the SCHEME dialect of LISP. DOE

N90-25627# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
THE INCORPORATION OF A MULTIGRID METHOD INTO THE ORTHOGONAL CURVILINEAR COORDINATE VERSION OF THE ROLLS-ROYCE PACE COMPUTER PROGRAM
A. Manners Dec. 1988 25 p
(TT-8804; ISBN-0-904947-09-2) Avail: NTIS HC A03/MF A01

The incorporation of a multigrid scheme into the Rolls-Royce PACE computer program is described. PACE is a computational fluid dynamics (CFD) program routinely used by Rolls-Royce to calculate the 3-D, turbulent, reacting flow in and around gas turbine combustion chambers. Because of the complexity of the flow, it is standard practice to use large numbers of grid points in attempting to reduce the numerical truncation error to an acceptable level. Consequently, each calculation requires about a day's CPU time on a large IBM mainframe or several hours on a Cray supercomputer. Clearly, a method which reduces the amount of computer time required for these large calculations would rapidly accrue large cost savings. Most iterative methods in CFD programs, such as the SIMPLE scheme used in PACE, require increasingly large numbers of iterations to reach convergence as the grid is refined. A multigrid scheme aims to keep the number of iterations required to reach convergence essentially independent of the number of grid points. However, since the multigrid scheme requires more work (CPU time) per iteration, the benefits only occur for relatively fine grids. The multigrid method is described. Author

N90-25628 Politecnico di Milano (Italy). Dipartimento di Elettronica.
MODULAR ARITHMETIC AND RANDOMIZATION FOR EXACT MATROID PROBLEMS: EXTENDED ABSTRACT
P. Camerini, G. Galbiati (Pavia Univ., Italy), and F. Maffioli 1989 18 p Sponsored in part by Italian Ministry of Public Education and Italian Ministry of University and Scientific Research (Grant NATO-RG-85-0240)
(Rept-89-064; ETN-90-97028) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Combinatorial problem solving by using random pseudo polynomial algorithms is addressed. Problems of finding a base of exact value in the intersection of two matroids and in a weighted graph are outlined. Faster algorithms for solving these same problems are presented which are sequential and random pseudo polynomial. ESA

N90-25629# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
ON TWO TRANSFORMATIONS IN THE GENERALIZED THEORY OF LINEAR SYSTEMS
A. C. Pugh and G. E. Hayton (Hull Univ., England) Jan. 1990 15 p
(MATHS-Rept-A-109; ETN-90-97044) Avail: NTIS HC A03/MF A01

Two transformations recently proposed for the generalized analysis of linear systems are established as appropriate generalizations of the usual transformations of the conventional theory. Two transformations are discussed: relating to state space models and general polynomial models. ESA

N90-25630# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
ON NULL TRATORIAL TORSION IN VACUUM QUADRATIC POINCARE GAUGE FIELD THEORY
P. Singh Feb. 1990 9 p
(MATHS-Rept-A-111; ETN-90-97045) Avail: NTIS HC A02/MF A01

The field equations of vacuum QPGFT (Quadratic Poincare Gauge Field Theory) are solved for purely null tratorial torsion. Expressing the contortion tensor for this case as K sub (lambda (mu)nu) = -2(g sub (lambda (mu)) - g sub (lambda (nu)) a sub (mu)), where a (mu) is null, that any solution of vacuum QPGFT, whose V sub 4 part is also a solution of Einstein's vacuum field equations with a cosmological constant, is necessarily of algebraic type N. This class of exact solutions has an expansion-free, shear-free and twist-free autoparallel repeated principal null congruence. The relationship between this class and a similar class with null axial vector torsion is also discussed. ESA

N90-25631# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
ON CONDITIONS GUARANTEEING TWO POLYNOMIAL MATRICES POSSESS IDENTICAL ZERO STRUCTURES
A. C. Pugh, D. S. Johnson, and G. E. Hayton (Hull Univ., England) Feb. 1990 13 p
(MATHS-Rept-A-123; ETN-90-97046) Avail: NTIS HC A03/MF A01

Some sufficient conditions for two polynomial matrices to simultaneously possess identical finite and infinite zero structures are developed. A special case of this problem, that of obtaining conditions under which a polynomial matrix has no infinite zeros, is also considered and certain connections with recent work established. ESA

N90-25632# Norwegian Defence Research Establishment, Kjeller.
AN ADAPTIVE FINITE ELEMENT METHOD FOR SHOCK DEVELOPING PARTIAL DIFFERENTIAL EQUATION
Jan Olav Langseth 17 Oct. 1989 154 p In NORWEGIAN; ENGLISH summary
(FFI-89/7014; ETN-90-97107) Avail: NTIS HC A08/MF A01

Simulation of physical problems which contain shock or large gradients imposes strong restrictions on the use of traditional numerical methods based on fixed nodes. Adaptative methods where the nodes are allowed to move were developed. An introduction to adaptative methods is given. The moving finite element method is the main focus. The method is applied to scalar Partial Differential Equations (PDEs) and to systems of PDEs. How to use the method equipped with several independent grids is described. Attention is payed to the choice of a proper initial distribution of the nodes. ESA

N90-25633# Norwegian Defence Research Establishment, Kjeller.
USING IMPLICIT ODE METHODS WITH ITERATIVE LINEAR EQUATION SOLVERS IN SPECTRAL METHODS
Ivar Lie 8 Nov. 1989 38 p
(FFI-89/7017; ISSN-0802-2437; ETN-90-97109) Avail: NTIS HC A03/MF A01

The use of Chebychev spectral methods in space on an evolution partial differential equation results in a system of Ordinary Differential Equations (ODEs). ODE solvers based on explicit methods are therefore inefficient for such equations. The application of ODE solvers with iterative linear equation solvers to ODEs coming from spectral discretizations is shown. The ODE solvers do not use the Jacobian explicitly. Preconditioners to the Jacobian are needed for efficient operations of the ODE solvers. ESA

N90-25634# Sheffield Univ. (England). Dept. of Control Engineering.
LIMIT CYCLES AND BIFURCATION IN PIECEWISE-LINEAR AND PIECEWISE-ANALYTIC SYSTEMS. 1: GENERAL THEORY
S. P. Banks and Saadi A. Khathur Aug. 1990 27 p
(RR-372; ETN-90-97114) Avail: NTIS HC A03/MF A01

Some theoretical aspects of limit cycles and bifurcation in piecewise-linear and piecewise-analytic systems are considered. In the case of piecewise-linear systems, an expression for the solution of the system by using the Campbell-Hausdorff formula is obtained. For piecewise-analytic systems, a generalized Lie series for the system solution is used and analytic series representation are obtained. Theoretical sufficient conditions are obtained directly in terms of the right hand sides of the system. ESA

N90-25635# Sheffield Univ. (England). Dept. of Control Engineering.
NON-LINEAR SYSTEMS IDENTIFICATION USING RADIAL BASIS FUNCTIONS

S. Chen, S. A. Billings, C. F. N. Cowan, and P. M. Grant (Edinburgh Univ., Scotland) Dec. 1989 41 p Sponsored by United Kingdom Science and Engineering Research Council
(RR-378; ETN-90-97120) Avail: NTIS HC A03/MF A01

The identification of discrete-time nonlinear systems is investigated using radial basis functions. A forward regression algorithm based on an orthogonal decomposition of the regression matrix is employed. A set of radial basis function centers is selected from a large number of possible candidates. An automatic selection procedure for identifying parsimonious radial basis function models of structure unknown nonlinear systems is provided. The relationship between neural networks and radial basis functions is discussed and the application of the algorithms to real data is included to demonstrate the effectiveness of this approach. ESA

N90-25079# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.). Unternehmensgruppe Raumfahrt.
HYBRID ANALYSIS: COUPLING OF THE FINITE ELEMENT METHOD WITH ANALYTICAL APPROACHES
Stefan Dieker *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 26-36 Presented at AAF DGLR RAeS-European Forum on Aeroelasticity and Structural Dynamics, Aachen, Fed. Republic of Germany, 17-19 Apr. 1989 (For primary document see N90-25075 19-01)
(MBB-UO-0048/89-PUB) Avail: NTIS HC A15/MF A02

N90-25087# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Hubschrauber und Flugzeuge.
SOLUTION OF THE OPTIMAL CONTROL PROBLEM USING THE SOFTWARE PACKAGE STOMP
Kathleen Horn *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 101-106 Presented at the 8th IFAC Workshop on Control Applications of Nonlinear Programming and Optimization, Paris, France, 7-9 Jun. 1989 (For primary document see N90-25075 19-01)
(MBB-FE-126/S/PUB-370) Avail: NTIS HC A15/MF A02

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N90-25636# Purdue Univ., West Lafayette, IN. Dept. of Statistics.
NONPARAMETRIC SELECTION, RANKING AND TESTING
Sayaji N. Hande Jan. 1990 26 p
(Contract N00014-88-K-0170; NSF DMS-87-02620)
(AD-A219254; TR-90-06) Avail: NTIS HC A03/MF A01
CSCL 12/2

In this paper we consider the problem of ranking (partitioning) k populations according to the parameter which is defined as functionals of the distribution functions on the underlying populations. We obtain minimax rules for general loss functions, Bayes rules for some specific loss functions and purpose approximate non-randomized minimax rules. We also derive restricted minimax rules for selecting a subset of populations which are better than a control. Some nonparametric optimal tests are derived for different hypotheses written in terms of the parameter as a functional of the underlying distribution function. GRA

N90-25637 Politecnico di Milano (Italy). Laboratorio di Calcolatori.
THE PROPOSAL OF A HIGH-LEVEL STOCHASTIC PETRI NET
Sandro Morasca 1990 36 p
(Rept-90-005; ETN-90-97031) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The modeling and analysis of concurrent systems requires new methods that can closely mirror their structure in a natural way. To this end, Petri nets are a good candidate, but in order to fully represent all of the features of a system, they must be extended so to include both temporal and stochastic characteristics of the system. A high level stochastic Petri net model is presented. The aim is to define such a model and to show that it can be seen as a generalization of the previous stochastic Petri net models and as a model that fills the gap between high level and stochastic Petri nets. It is capable of representing situations which other stochastic Petri net models cannot cope with. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N90-25638*# Boeing Advanced Systems Co., Seattle, WA.
RELIABILITY MODEL GENERATOR SPECIFICATION Final Report
Gerald C. Cohen and Catherine McCann Mar. 1990 247 p
(Contract NAS1-18099)
(NASA-CR-182005; NAS 1.26:182005) Avail: NTIS HC A11/MF A02 CSCL 12B

The Reliability Model Generator (RMG), a program which produces reliability models from block diagrams for ASSIST, the interface for the reliability evaluation tool SURE is described. An account is given of motivation for RMG and the implemented algorithms are discussed. The appendices contain the algorithms and two detailed traces of examples. Author

N90-25639# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
SYNTHESIS AND VALIDATION OF FEEDBACK GUIDANCE LAWS FOR AIR-TO-AIR INTERCEPTIONS
Josef Shinar and Hendrikus Visser Jan. 1990 69 p
(LR-615; ETN-90-97178) Avail: NTIS HC A04/MF A01

A multi-year research effort to develop and validate a feedback algorithm for medium range air-to-air interceptions with realistic capture conditions, compatible with the deployment of advanced guided weapons in a future air combat scenario is summarized. Previous work is reviewed and new results are presented. The proposed guidance algorithm is based on the application of singular perturbation techniques. The examples included, featuring both previous generation (F-4) and state of the art (F-15) fighter aircraft models, demonstrate the structural robustness of the feedback guidance laws. The hierarchical structure of the algorithm, the explicit feedback form of the control laws and the validated high accuracy, make the algorithm a very attractive candidate for a real time implementation on board a future interceptor aircraft. ESA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N90-25640*# Illinois Univ., Chicago.
HOPF-ALGEBRAIC STRUCTURE OF COMBINATORIAL OBJECTS AND DIFFERENTIAL OPERATORS
Robert Grossman and Richard G. Larson Jul. 1989 10 p
(Grants NAG2-513; NSF DMS-87-01085)
(NASA-CR-186360; NAS 1.26:186360) Avail: NTIS HC A02/MF A01 CSCL 12A

A Hopf-algebraic structure on a vector space which has as basis a family of trees is described. Some applications of this structure to combinatorics and to differential operators are surveyed. Some possible future directions for this work are indicated. Author

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N90-25641 Department of the Navy, Washington, DC.
TERBIUM-DYSPROSIUM MAGNETOSTRICTIVE HIGH POWER TRANSDUCERS Patent
Arthur E. Clark, inventor (to Navy) 6 Mar. 1990 6 p Filed 30 Jun. 1989
(AD-D014509; US-Patent-4,906,879; US-Patent-Appl-SN-374119; US-Patent-Class-310-26) Avail: US Patent and Trademark Office CSCL 20/3

Magnetic energy is converted into mechanical energy by applying a changing magnetic field to a rare earth alloy of the formula. Tb(x)Dy(1-x) at a temperature in the range of about 0 to 170 K, wherein x and the operating temperature are selected to minimize the basal plane anisotropy. GRA

N90-25642*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CENTER FOR SPACE MICROELECTRONICS TECHNOLOGY 1988-1989 TECHNICAL REPORT
Peggy Olsen 1 Mar. 1990 121 p
(Contract NAS7-918)
(NASA-CR-186849; NAS 1.26:186849; JPL-Publ-90-3) Avail: NTIS HC A06/MF A01 CSCL 20C

The 1988 to 1989 Technical Report of the JPL Center for Space Microelectronics Technology summarizes the technical accomplishments, publications, presentations, and patents of the center. Listed are 321 publications, 282 presentations, and 140 new technology reports and patents. Author

N90-25643# Sheffield Univ. (England). Dept. of Control Engineering.
THE INTERPRETATION OF NONLINEAR FREQUENCY RESPONSE FUNCTIONS
S. A. Billings and J. C. PeytonJones 17 Nov. 1989 45 p
(RR-375; ETN-90-97117) Avail: NTIS HC A03/MF A01

Analytical and graphical methods of interpreting multidimensional frequency response functions for nonlinear systems are derived. It is shown that nonlinear phenomena can be classified into intrakernel and interkernel interference. The mechanism for reducing dimensionality gives insights into describing function analysis and enables the worst case response for a specified class of inputs and order analysis to be determined. The results are illustrated using several discrete and continuous time nonlinear systems. ESA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N90-25644# Army Cold Regions Research and Engineering Lab., Hanover, NH.
LABORATORY STUDIES OF ACOUSTIC SCATTERING FROM THE UNDERSIDE OF SEA ICE
Timothy K. Stanton, Clarence S. Clay, and Kenneth C. Jezek 1989 6 p Prepared in cooperation with Wisconsin Univ., Madison
(Contract N00014-84-K-0611)
(AD-A221333) Avail: NTIS HC A02/MF A01 CSCL 20/1

The acoustic properties of sea ice were studied. Important dependences were observed of acoustic properties of sea ice upon ice type and environmental conditions which was a result of the careful measurements of ice morphology that were concurrent with the acoustic measurements. As a result of the studies, semi-empirical acoustic models were formulated of the water/ice interface that can be used as input into scattering and propagation models. GRA

N90-25645*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EVALUATION OF WATER COOLED SUPERSONIC TEMPERATURE AND PRESSURE PROBES FOR APPLICATION TO 2000 F FLOWS
Nicholas T. Lagen (George Washington Univ., Hampton, VA.) and John M. Seiner Jun. 1990 82 p Presented at the 36th International Instrumentation Symposium, Denver, CO, 6-10 May 1990
(NASA-TM-102612; NAS 1.15:102612) Avail: NTIS HC A05/MF A01 CSCL 20A

The development of water cooled supersonic probes used to study high temperature jet plumes is addressed. These probes are: total pressure, static pressure, and total temperature. The motivation for these experiments is the determination of high temperature supersonic jet mean flow properties. A 3.54 inch exit diameter water cooled nozzle was used in the tests. It is designed for exit Mach 2 at 2000 F exit total temperature. Tests were conducted using water cooled probes capable of operating in Mach 2 flow, up to 2000 F total temperature. Of the two designs tested, an annular cooling method was chosen as superior. Data at the jet exit planes, and along the jet centerline, were obtained for total temperatures of 900 F, 1500 F, and 2000 F, for each of the probes. The data obtained from the total and static pressure probes are consistent with prior low temperature results. However, the data obtained from the total temperature probe was affected by the water coolant. The total temperature probe was tested up to 2000 F with, and without, the cooling system turned on to better understand the heat transfer process at the thermocouple bead. The rate of heat transfer across the thermocouple bead was greater when the coolant was turned on than when the coolant was turned off. This accounted for the lower temperature measurement by the cooled probe. The velocity and Mach number at the exit plane and centerline locations were determined from the Rayleigh-Pitot tube formula. Author

N90-25646# Lawrence Livermore National Lab., CA.
LISTENING TO TURBULENCE: AN EXAMPLE OF SCIENTIFIC AUDIOLIZATION
Meera M. Blattner, Robert M. Greenberg (San Francisco Conservatory of Music, CA.), and Minao Kamegai 1990 9 p Presented at the ACM SIGCHI 1990 Workshop on Multimedia and Multimodal Interface Design, Seattle, WA, 1-2 Apr. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE90-010637; UCRL-JC-103579; CONF-9004187-1) Avail: NTIS HC A02/MF A01

The problem of how to enhance, or even replace, scientific visualization with sound is examined. This is called scientific audiolization. The problem selected was that of turbulence in fluid flow. Turbulence is one of the most difficult subjects to understand in physics and engineering. Most fluid flow is turbulent and turbulence is not understood from first principles. For this reason, the visualization of turbulent behavior on the part of fluids is of great use to the scientist. However, there is information associated with turbulence that is not easily visualized. As such, the problem of accurately depicting turbulence lends itself well to a combination of graphic and sonic elements. Sound may also be used to represent data or messages. A message may be displayed in text or voice, but it may also be communicated through a signal called earcons. One of the goals is to suggest a model for the simultaneous use of both representational sounds and sound messages (earcons) in a computer/user interface. The audio and graphical representation can be presented to the user in a single multimedia interface (audiovisualization). The first use of sound is the representation turbulent behavior, such as rushing water or the sound of jet engines. The second use of sound is in the transmission of messages pertaining to turbulence. Aspects of turbulence might all be communicated via sound messages, i.e., earcons, such as mathematical singularities, the rate of dissapation of energy, or the handedness of a vortex. DOE

N90-25647*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXPERIMENTAL VALIDATION STUDY OF AN ANALYTICAL MODEL OF DISCRETE FREQUENCY SOUND PROPAGATION IN CLOSED-TEST-SECTION WIND TUNNELS
Marianne Mosher May 1990 76 p
(NASA-TM-102801; A-90103; NAS 1.15:102801) Avail: NTIS HC A05/MF A01 CSCL 20A

The principal objective is to assess the adequacy of linear acoustic theory with an impedence wall boundary condition to model the detailed sound field of an acoustic source in a duct. Measurements and calculations are compared of a simple acoustic source in a rectangular concrete duct lined with foam on the walls and anechoic end terminations. Measurement of acoustic pressure for twelve wave numbers provides variation in frequency and absorption characteristics of the duct walls. Close to the source, where the interference of wall reflections is minimal, correlation is very good. Away from the source, correlation degrades, especially for the lower frequencies. Sensitivity studies show little effect on the predicted results for changes in impedance boundary condition values, source location, measurement location, temperature, and source model for variations spanning the expected measurement error. Author

N90-25648# European Space Agency, Paris (France).
DATA OF AERO ACOUSTIC MEASUREMENTS ON ULTRA-LIGHT AIRCRAFT PROPELLERS
Helmut Dahlen and Birgit Ketthaus (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) May 1990 119 p Transl. into ENGLISH from Messergebnisse aeroakusischer Untersuchungen an Ultraleichtflugzeug-Propellern (Brunswick, Fed. Republic of Germany, DFVLR), May 1988 108 p Original language document was announced as N89-25677
(ESA-TT-1147; DFVLR-Mitt-89-33; ETN-90-97074) Avail: NTIS HC A06/MF A01 DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 40.50 DM

Results of aero acoustic wind tunnel measurements on 6 ultralight aircraft propellers (2, 3, 4 and 6 blades) are presented numerically and graphically. They include thrust, torque and noise in the helical Mach number range of 0.4 to 0.7 and propeller pitch angles of 10 to 25 degrees. ESA

N90-25080# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Zentralbereich Technik.
GRADIENT MICROPHONE FOR MEASUREMENT OF THE VECTORIAL SOUND VELOCITY [GRADIENTENMIKROFON ZUR MESSUNG DER VEKTORIELLEN SCHALLSCHNELLE]
Oskar Bschorr *In its* Research and Development: Technical and Scientific Publications 1989 p 37-40 In GERMAN Presented at 15th the Gemeinschaftstagung mit Kolloquium der Deutschen Arbeitsgemeinschaft fuer Akustik, Duisburg, Fed. Republic of Germany, 13-16 Mar. 1989 (For primary document see N90-25075 19-01)
(MBB-Z-0259/89-PUB) Avail: NTIS HC A15/MF A02

N90-25104# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensgruppe Wehrtechnik.
AERO-ACOUSTIC INVESTIGATIONS OF THE MAGNETIC TRAIN TRANSRAPID 06
Hans Alscher *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 325-330 Presented at the 11th International Conference on Magnetically Levitated Systems and Linear Drives, Yokohama, Japan, 8 Jul. 1989 (For primary document see N90-25075 19-01)
(MBB-UW-0009/89-PUB) Avail: NTIS HC A15/MF A02

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N90-25649# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
TRAPS FOR NEUTRAL ATOMS Annual Report, 1 Sep. 1988 - 31 Aug. 1989
David Pritchard, Michael Joffe, Kristian Helmerson, Min Xiao, and Ke-Xun Sun 31 Aug. 1989 7 p
(Contract N00014-83-K-0695)
(AD-A221331) Avail: NTIS HC A02/MF A01 CSCL 20/5

Large numbers of neutral atoms were trapped and cooled to millikelvin temperatures. The next objective is to cool them to microkelvin temperatures. Dense samples of atoms cooled to microkelvin temperatures promise to open up new and exciting areas of physics. The lack of interaction of the low velocity atoms due to their reduced thermal motion, together with the possibility of indefinitely long interaction times, make samples of trapped atoms ideal for high resolution spectroscopy and for use as atomic frequency standards. The main current effort in neutral atom trapping is cooling of trapped atoms to low temperatures. While this remains a difficult and elusive goal (to date, micro-kelvin temperatures have only been achieved with untrapped atoms), the rewards for supercooling trapped atoms appear to be high. The long confinement times, together with the reduced thermal motion of cold atoms, could result in a new era of ultra-high resolution spectroscopy and precise frequency standards. Potentially more exciting is the possibility of combining the high densities achievable in traps and the long deBroglie wavelength of ultracold atoms to observe novel quantum collective phenomena. GRA

N90-25650*# Hampton Inst., VA.
ONE DIMENSIONAL HEAVY ION BEAM TRANSPORT: ENERGY INDEPENDENT MODEL M.S. Thesis
Hamidullah Farhat Apr. 1990 85 p
(Grant NAG1-656)
(NASA-CR-186722; NAS 1.26:186722) Avail: NTIS HC A05/MF A01 CSCL 20H

Attempts are made to model the transport problem for heavy ion beams in various targets, employing the current level of understanding of the physics of high-charge and energy (HZE) particle interaction with matter are made. An energy independent transport model, with the most simplified assumptions and proper parameters is presented. The first and essential assumption in this case (energy independent transport) is the high energy characterization of the incident beam. The energy independent equation is solved and application is made to high energy neon (NE-20) and iron (FE-56) beams in water. The numerical solutions is given and compared to a numerical solution to determine the accuracy of the model. The lower limit energy for neon and iron to be high energy beams is calculated due to Barkas and Burger theory by LBLFRG computer program. The calculated values in the density range of interest (50 g/sq cm) of water are: 833.43 MeV/nuc for neon and 1597.68 MeV/nuc for iron. The analytical solutions of the energy independent transport equation gives the flux of different collision terms. The fluxes of individual collision terms are given and the total fluxes are shown in graphs relative to different thicknesses of water. The values for fluxes are calculated by the ANASTP computer code. Author

N90-25651*# Fermi National Accelerator Lab., Batavia, IL.
COSMIC STRINGS AND BARYON DECAY
Ruth Gregory Apr. 1990 11 p
(Grant NAGw-1340)
(NASA-CR-182842; NAS 1.26:182842; FERMILAB-Pub-90/135-A) Avail: NTIS HC A03/MF A01 CSCL 20H

The current literature is reviewed on baryon decay catalysis by cosmic string. A summary is presented of the main arguments for decay catalysis. Author

N90-25530*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EXPERIMENTAL !NVESTIGATIONS OF LOW-ENERGY (4 TO 40 eV) COLLISIONS OF O(-)(P2) IONS AND O(P3) ATOMS WITH SURFACES
A. Chutjian, O. J. Orient, and E. Murad (Air Force Geophysics Lab., Hanscom AFB, MA.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 263-268 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 20H

N90-25531*# Los Alamos National Lab., NM. Chemical and Laser Sciences Div.
LABORATORY INVESTIGATIONS: LOW EARTH ORBIT ENVIRONMENT CHEMISTRY WITH SPACECRAFT SURFACES
Jon B. Cross *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 269-275 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 20H

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N90-25652# Continuous Electron Beam Accelerator Facility, Newport New, VA.
USE OF THE TACL SYSTEM AT CEBAF FOR CONTROL OF THE CRYOGENIC TEST FACILITY
Edwin Navarro, Marie Keesee, Rolf Bork, Caroline Grubb, George Lahti, and Joan Sage 18 Jul. 1989 6 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-024) Avail: NTIS HC A02/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

A logic-based control software system, called Thaumaturgic Automated Control Logic (TACL), is under development at the Continuous Electron Beam Accelerator Facility. The first version of the software was placed in service for control of cryogenics during the first superconducting RF cavity at CEBAF. The control system was installed at the Cryogenic Test Facility (CTF) at CEBAF. CTF generated liquid helium in September, 1988 and is now in full operation for the current round of cavity tests. TACL is providing a powerful and flexible controls environment for the operation of CTF. Author

N90-25653# Continuous Electron Beam Accelerator Facility, Newport New, VA.
RF CONTROL SYSTEM DEVELOPMENT AT CEBAF
S. Simrock, C. Hovater, S. Jones, and Jock Fugitt 29 Sep. 1989 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-026) Avail: NTIS HC A01/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

The Continuous Electron Beam Accelerator Facility (CEBAF) RF control system uses a heterodyne scheme to convert the cavity frequency of 1497 MHz down to a more manageable IF frequency of 70 MHz. At this IF frequency all the signal processing is done. Because of the tight system requirements of + or - 0.2 deg phase stability and + or - 2.10 (exp -5) amplitude stability, CEBAF uses new technologies such as high speed analog circuits at 70 MHz. Major themes include components for signal processing in the control system and recent system performance tests. Author

N90-25654# Continuous Electron Beam Accelerator Facility, Newport New, VA.
THERMIONIC GUN CONTROL SYSTEM FOR THE CEBAF INJECTOR
Randolph Pico, Bill Diamond, Jock Fugitt, and Rolf Bork 29 Sep. 1989 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-028) Avail: NTIS HC A01/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

The injector for the CEBAF accelerator must produce a high quality electron beam to meet the overall accelerator specifications. A Hermosa electron gun with a 2 mm-diameter cathode and a control aperture was chosen as the electron source. This must be controlled over a wide range of operating conditions to meet the beam specifications and to provide flexibility for accelerator commissioning. The gun is controlled using Computer Automated Measurement and Control (CAMAC IEEE-583) technology. The system employs the CAMAC-based control architecture developed at CEBAF. The control system was tested, and early operating data on the electron gun and the injector beam transport system was obtained. This system also allows gun parameters to be stored at the operator location, without paralyzing operation. The use is described of this computer system in the control of the CEBAF electron gun. Author

N90-25655# Continuous Electron Beam Accelerator Facility, Newport New, VA.
STATUS OF THE CEBAF INJECTOR
W. T. Diamond and Randolph Pico 29 Sep. 1989 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-027) Avail: NTIS HC A01/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

The injector for the CEBAF CW superconducting linac consists of a 100 keV electron gun, two choppers and a buncher. A short, room temperature, graded-beta, sidecoupled accelerator is used to increase the electron beam energy to about 500 keV to produce a good match into the first superconducting accelerator cavity. Eighteen five-cell superconducting cavities are used to produce an energy of 45 MeV before injection into the first linac. All of the room temperature centerline hardware was installed on a strongback. Testing of the 100 keV electron gun and transport system is in progress. The RF system for the choppers and buncher is nearly complete and the first tests are in progress. Author

N90-25656# Continuous Electron Beam Accelerator Facility, Newport New, VA.
CHARACTERISTIC IMPEDANCES AND LOSS DATA FOR A COMMON STRIPLINE PICKUP GEOMETRY
Walter Barry and S. Y. R. Liu (Virginia Polytechnic Inst. and State Univ., Blacksburg.) 3 Nov. 1989 14 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-038) Avail: NTIS HC A03/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

Most particle accelerators routinely employ some type of stripline pickups and/or kickers. Characteristic impedance and resistance per unit length are calculated for a strip transmission line geometry consisting of a circular outer conductor and an infinitely thin concentric inner conductor which subtends an angle phi(sub 0) in azimuth. Useful design plots for these parameters as functions of phi(sub 0) and inner to outer conductor radius ratio, b/a, are given. Author

N90-25657# Continuous Electron Beam Accelerator Facility, Newport New, VA. Instrumentation and Control Group.
THE CEBAF INSTRUMENTATION AND CONTROL SYSTEM
Robert Rossmanith 3 Nov. 1989 8 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-037) Avail: NTIS HC A02/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

CEBAF is a 5-pass recirculating superconducting CW linac for energies up to 4 GeV. The project is in the construction phase. The maximum CW current will be 200 micro-A. A recirculating linac requires a control system which has to be tailored to the requirements of this new type of machine. Author

N90-25658# Continuous Electron Beam Accelerator Facility, Newport New, VA.
DESIGN OF CEBAF'S RF SEPARATOR AND RESULTS OF COLD TESTS
C. G. Yao [1989] 7 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-021) Avail: NTIS HC A02/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

The design of the Continuous Electron Beam Accelerator Facility (CEBAF) accelerator system is based upon a multipass racetrack configuration, the straight sections of which will utilize 1497-MHz superconducting linac sections with independent magnetic transport at the end of each linac segment. Room-temperature SW RF separators operating at a frequency of 998 MHz will be used in each independent transport channel at one end of the racetrack to extract a portion of the recirculating current. With the frequency chosen and appropriate phasing, three independent beams of correlated energy may be extracted for use in the three experimental areas. The design of the RF separators, based on an alternating periodic structure (APS), are described and some preliminary prototype cold test results are given. Author

N90-25659# Continuous Electron Beam Accelerator Facility, Newport New, VA.
POLARIZATION OBSERVABLES IN DEUTERON PHOTO- AND ELECTRO-DISINTEGRATION
V. Dmitrasinovic and Franz Gross (College of William and Mary, Williamsburg, VA.) [1989] 55 p
(Contracts DE-AC05-84ER-40150; DE-FG05-88ER-40435)
(CEBAF-PR-89-022; WM-89-03) Avail: NTIS HC A04/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

A comprehensive relativistic treatment of polarization observables in deuteron photo- and electro-disintegration is presented from a unified standpoint. A discussion of necessary and sufficient measurements needed for a complete determination of all transition amplitudes is given. Author

N90-25660# Continuous Electron Beam Accelerator Facility, Newport New, VA.
ON USING A SUPERCONDUCTING LINAC TO DRIVE A SHORT WAVELENGTH FEL
G. A. Krafft and Joseph J. Bisognano [1989] 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-019) Avail: NTIS HC A01/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

In order to determine the suitability of using a superconducting radio frequency (SRF) linac to generate XUV radiation, the beam dynamics in such a linac were simulated using a vectorized 2-D beam breakup code, TDBBU. The energy spread and emittance of the accelerated beam are determined as a function of current for a linac like CEBAF and for a linac optimized for high peak currents. The results indicate that there are significant improvements in transverse emittance growth possible by going to lower RF frequencies and by utilizing BNS phasing in the accelerating cavities. The simulation is described. Next, the transverse and longitudinal wakes typical in superconducting cavities are discussed. The results of the simulations are given, followed by a comparison of a linac driven free electron laser (FEL) and a typical storage ring driven FEL. The conclusion is that the former scheme looks promising because higher average power is possible. Author

N90-25661# Continuous Electron Beam Accelerator Facility, Newport New, VA.
HIGH REPETITION RATE KICKERS FOR LINEAR COLLIDERS
S. A. Heifets and Robert Rossmanith [1989] 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-020) Avail: NTIS HC A01/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

It has been shown that kickers with a high repetition rate can be designed by combining several cavities operating in a deflecting mode. This idea is simplified by showing that such kickers can be built also with one cavity or with an assembly of coupled cavities operating at several frequencies. It is also demonstrated that this concept can be used for accelerating cavities. The electrical breakdown limit for such multimode accelerating cavities will be significantly higher than conventional single-mode cavities; therefore higher acceleration gradients, e.g., for linear colliders, can be achieved. Author

N90-25662# Continuous Electron Beam Accelerator Facility, Newport New, VA.
REQUIREMENTS FOR LONGITUDINAL HOM DAMPING IN SUPERCONDUCTING RECIRCULATING LINACS
Joseph J. Bisognano and Michael L. Fripp 16 May 1990 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-018) Avail: NTIS HC A01/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

Transverse beam breakup provides the primary current limitation in the operation of superconducting recirculating linacs and requires the significant damping of transverse-deflecting higher order modes (HOMs). The need to damp the coexisting longitudinal HOMs in these nominally isochronous machines, however, is not as clear. Isochronicity implies that energy variations induced by excitation of longitudinal modes do not translate directly into position and current modulations. Such modulations, if present, could enhance the initial excitation, effectively closing a potentially unstable feedback loop. Design optimation of cavity structures may suggest that no longitudinal damping be provided. On the other hand, easing of the isochronicity requirement may provide desired flexibility in lattice design. Limits are placed on the requirements for longitudinal HOM damping and on the tolerances for isochronicity which are driven by possible longitudinal multi-pass phenomena. Author

N90-25663# Continuous Electron Beam Accelerator Facility, Newport New, VA.
IMPEDANCE AND WAKEFIELDS BEYOND CUTOFF
Joseph J. Bisognano [1989] 8 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-016) Avail: NTIS HC A02/MF A01

The short bunch lengths and the associated high frequencies found in the latest designs of linear colliders, superconducting linacs, free electron laser (FEL) drivers, damping rings, and synchrotron light sources have heightened the importance of understanding the high frequency behavior of the interaction of an accelerator beam with its environment. Uncertainty in the coupling of a particle beam to vacuum chamber discontinuities has hindered evaluation of bunch lengthening in storage rings and transverse beam blowup in linacs, and limits confidence in assessments of beam quality in proposed designs. Recent efforts have addressed the asymptotic frequency behavior of the longitudinal and transverse coupling impedance generated by discontinuities. Of particular interest is the transition from a slow rolloff, characteristic of isolated structures, to a more rapid rolloff, characteristic of an infinitely repeating structure. There has been significant progress in clarifying the implications of various length scales and geometries on the behavior of coupling impedances. Another high frequency phenomenon, which is of particular concern in damping and storage rings, is the synchrotron radiation process in the presence of conductive boundaries. Results which take into account fully the complex, finite-Q resonance structure present in a closed vacuum toroid are of concern. An overview is presented

of the current understanding of impedances and wakefields well above the beam pipe cutoff. Implications of these results to beam dynamics issues are discussed, and a few remarks on remaining questions are offered. Author

N90-25664# Continuous Electron Beam Accelerator Facility, Newport New, VA.
A SIMPLE BEAM POSITION MONITOR SYSTEM FOR CEBAF
Walter Barry, Robert Rossmanith, and M. Wise 23 Jun. 1989 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-015) Avail: NTIS HC A01/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

CEBAF is a recirculating linac where the beam passes several times through the linac structures. As a result, up to five beams of different energies may be present in the same linac vacuum chambers simultaneously. One method of distinguishing between the beams involves modulating the current for a time interval of less than one revolution period. A very simple low cost beam position monitor system based on the detection of this modulation is presented. Initial results indicate that 1 mm displacements for beam currents of 1 micro-A can be measured. With the incorporation of several improvements to the present monitor design, the sensitivity is expected to be increased to 1 mm for a 100 nA beam. Author

N90-25665# Continuous Electron Beam Accelerator Facility, Newport New, VA.
ANALYTIC STUDY OF THE HIGH-FREQUENCY IMPEDANCE
S. A. Heifets [1989] 21 p Presented at the FEL's and Storage Rings Workshop, Dortmund, Fed. Republic of Germany, Sep. 1988
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-014) Avail: NTIS HC A03/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

The interaction of short bunches with the beam environment is described using simple models. The impedances of typical elements of an accelerator structure are obtained. The cross-talk between elements, the impedance of a periodic array, and the effect of tapering are discussed. The results allow fast estimate of the high frequency impedance with reasonable accuracy for a cavity of arbitrary shape and give a guideline for impedance optimization. Author

N90-25666# Continuous Electron Beam Accelerator Facility, Newport New, VA.
CEBAF CONTROL SYSTEM
Rolf Bork, Caroline Grubb, George Lahti, Edwin Navarro, Joan Sage, and T. Moore (Lawrence Livermore National Lab., CA.) [1989] 5 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-013) Avail: NTIS HC A01/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

A logic-based computer control system is in development at the Continuous Electron Beam Accelerator Facility (CEBAF). This Unix/C language software package, running on a distributed, hierarchical system of workstation and supervisory minicomputers, interfaces to hardware via Computer Automated Measurement and Control (CAMAC). Software aspects covered are ladder logic, interactive database generation, networking, and graphic user interfaces. Author

N90-25667# Continuous Electron Beam Accelerator Facility, Newport New, VA.
LEP AND CEBAF POLARIMETERS
M. Placidi (European Organization for Nuclear Research, Geneva, Switzerland), V. Burkert, and Robert Rossmanith [1989] 10 p Presented at the 8th International Symposium on High Energy Spin Physics, Minneapolis, MN, Sep. 1988
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-89-010) Avail: NTIS HC A02/MF A01; also available from CEBAF Library, 12000 Jefferson Ave., Newport News, VA 23606

An overview is given on high energy electron (positron) polarimeters by describing in more detail the plans for the LEP polarimeter and the CEBAF polarimeters. Both LEP and CEBAF will have laser polarimeters. In addition CEBAF will be equipped with a Moller polarimeter (for currents below 1 micro-A) Author

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N90-25668# Department of the Navy, Washington, DC.
DIFFERENTIAL POLARIMETRIC FIBER OPTIC SENSOR Patent Application
A. D. Kersey, inventor (to Navy) 16 Jan. 1990 17 p
(AD-D014501; US-Patent-Appl-SN-465677) Avail: NTIS HC A03/MF A01 CSCL 20/6

This patent application discloses a differential polarimetric fiber optic sensor in which a local compensating fiber section is spatially separated from a remote sensing fiber section by input and output polarization-maintaining fibers in order to permit the remote passive interrogation of the remote sensing fiber section by the direct polarization analysis of the light at the output of the local compensating fiber section. GRA

N90-25669# Department of the Navy, Washington, DC.
MONOLITHIC OPTICAL PROGRAMMABLE SPECTROGRAPH (MOPS) Patent Application
Paul B. Dorain, inventor (to Navy) and Judith Snow, inventor (to Navy) 21 Nov. 1989 9 p
(AD-D014502; US-Patent-Appl-SN-417623) Avail: NTIS HC A02/MF A01 CSCL 20/6

The Monolithic Optical Programmable Spectrograph (MOPS) is a rugged, vibration resistant, inexpensive, compact spectrograph. It is capable of simultaneous multi-channel measurements of wavelengths and bandwidths of sources in the visible light and near infrared spectrums and has a resolution more than sufficient to resolve the near infrared 1060 nm wavelengths in the first order from the optical wavelengths 454, 472, 488, 496, 514, and 532 nm in the second order. The MOPS has sufficient linear space at the exit focal plane to accommodate a standard linear diode array package. This means that the wavelength dispersion is sufficient so that the wavelengths of interest are spread over about two centimeters. The spectrograph uses a grating with a large number of grooves/mm blazed to scatter light in second order. This enables the spectrograph to be smaller by a factor of two than if the grating were operating in the first order. The MOPS utilizes the favorable geometry for the spectrograph that is afforded by the Czerny-Turner geometric configuration. It is constructed by BK7 optical glass for rigidity. GRA

N90-25670# Department of the Navy, Washington, DC.
OPTICAL HIGH-SPEED PARALLEL BACKPLANE Patent Application
Albert J. Corda, inventor (to Navy) 29 Jan. 1990 12 p
(AD-D014504; US-Patent-Appl-SN-471316) Avail: NTIS HC A03/MF A01 CSCL 20/6

An optical backplane for use in a high-speed, parallel signal processing system is discussed. A plurality of circular shaped optical conductors are arranged in a cylindrical topology. A plurality of printed circuit card connectors are disposed radially about the perimeter of the optical conductors. Each connector consists of a linear array of optical transceivers. The lens of each optical transceiver is mounted in a socket provided at the perimeter of each optical conductor. The optical transceivers convert electrical data information from printed circuit boards plugged into the circuit card connectors into optical data information. The optical data information propagates throughout the optical conductor thereby allowing data to be shared by the printed circuit boards. GRA

N90-25671 Department of the Navy, Washington, DC.
OPTICAL MOTION DETECTOR DETECTING VISIBLE AND NEAR INFRARED LIGHT Patent
Hobart R. Everett, Jr., inventor (to Navy) 20 Feb. 1990 10 p Filed 31 May 1989
(AD-D014515; US-Patent-4,902,887; US-Patent-Appl-SN-359249; US-Patent-Class-250-221) Avail: US Patent and Trademark Office CSCL 17/5

An optical motion detector detects changes in scene lighting indicative of motion and is also capable of detecting surveillance by active night vision devices using near-infrared light. The detector includes two photodetectors which each provide data to a signal processing network. One photodetector is sensitive to visible light; the other to near-infrared light. Both signal processing networks are identical and include a sample-and-hold, a comparator network, and a pulse stretcher. The output of a photodetector is provided to the sample-and-hold and comparator network. The comparator network compares a voltage corresponding to the instantaneously detected ambient lighting scene with a voltage corresponding to a reference lighting scene. The pulse stretcher receives the output of the comparator network and in turn provides an output to a logical processor. The logical processor compares the outputs of both signal processing networks and provides an output indicating surveillance with near-infrared light. The logical processor also indicates any perturbations in intensities of incandescent and fluorescent light. GRA

N90-25672# Department of the Army, Washington, DC.
ALL-OPTICAL DEVICE AND METHOD FOR REMAPPING IMAGES Patent Application
John L. Johnson, inventor (to Army) 20 Feb. 1990 13 p
(AD-D014540; US-Patent-Appl-SN-481922) Avail: NTIS HC A03/MF A01 CSCL 20/6

An all-optical polar transform device transforms animage in rectangular coordinates into an image in polar coordinates by reflecting an input image-containing beam from a series of suitably positioned reflective surfaces and finally transmits the beam out as an output beam containing the transformed image. GRA

N90-25673*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MODE-MEDIUM INSTABILITY AND ITS CORRECTION WITH A GAUSSIAN REFLECTIVITY MIRROR
K. L. Webster and C. C. Sung (Alabama Univ., Huntsville.) Washington Jun. 1990 26 p
(NASA-TP-3023; NAS 1.60:3023) Avail: NTIS HC A03/MF A01 CSCL 20F

A high power CO2 laser beam is known to deteriorate after a few microseconds due to a mode-medium instability (MMI) which results from an intensity dependent heating rate related to the vibrational-to-translational decay of the upper and lower CO2 lasing levels. An iterative numerical technique is developed to model the time evolution of the beam as it is affected by the MMI. The technique is used to study the MMI in an unstable CO2 resonator with a hard-edge output mirror for different parameters like the Fresnel number and the gas density. The results show that the mode of the hard edge unstable resonator deteriorates because of the diffraction ripples in the mode. A Gaussian-reflectivity mirror was used to correct the MMI. This mirror produces a smoother intensity profile which significantly reduces the effects of the MMI. Quantitative results on peak density variation and beam quality are presented. Author

N90-25674*# David Sarnoff Research Center, Princeton, NJ.
MONOLITHIC ARRAYS OF GRATING-SURFACE-EMITTING DIODE LASERS AND QUANTUM WELL MODULATORS FOR OPTICAL COMMUNICATIONS
N. W. Carlson, G. A. Evans, S. K. Liew, and C. J. Kaiser 1990 18 p Submitted for publication
(Contract NAS1-18525)
(NASA-CR-186772; NAS 1.26:186772) Avail: NTIS HC A03/MF A01 CSCL 20F

The electro-optic switching properties of injection-coupled coherent 2-D grating-surface-emitting laser arrays with multiple gain sections and quantum well active layers are discussed and demonstrated. Within such an array of injection-coupled grating-surface-emitting lasers, a single gain section can be operated as intra-cavity saturable loss element that can modulate the output of the entire array. Experimental results demonstrate efficient sub-nanosecond switching of high power grating-surface-emitting laser arrays by using only one gain section as an intra-cavity loss modulator. Author

N90-25675# Lawrence Livermore National Lab., CA.
SOL-GEL PROCESSING FOR FIBER OPTIC APPLICATIONS
Ian M. Thomas Nov. 1989 12 p Presented at the Materials Research Society Fall Meeting, Boston, MA, 27 Nov. - 2 Dec. 1989
(Contract W-7405-eng-48)
(DE90-012083; UCRL-101764; CONF-891119-134) Avail: NTIS HC A03/MF A01

The sol-gel process is a versatile process for the preparation of many types of glass and ceramics. This includes optical fibers. The general principles of sol-gel processing are described first. This is followed by details of the specific methods that can be used for the fabrication of optical fibers. Finally, some conclusions are drawn as to the commercial potential of the various methods. DOE

N90-25676 Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (Germany, F.R.).
ACOUSTO-OPTICAL LOCALIZATION OF SPEED MANEUVERING FLIGHT TARGETS
F. Dommermuth Nov. 1989 30 p In GERMAN; ENGLISH summary Sponsored by Bundesministers der Verteidigung
(FB-11-89; Lfd-292; ETN-90-96783) Avail: Forschungsinstitut fuer Hochfrequenzphysik, Wachtberg-Werthhoven, Fed. Republic of Germany

A trajectory estimation for maneuvering flight targets by combining of the acoustic readings of several sensors is transcribed in the case of a sensor giving optical readings. Acoustic and optical sensors could be located in the same place. Simulations confirmed the feasibility of the concept and the theoretically evaluated error limits. By taking into account the video recordings, realized with primitive equipment, the utilization satisfies real data. ESA

N90-25519*# Photometrics, Inc., Woburn, MA.
GASEOUS OPTICAL CONTAMINATION OF THE SPACECRAFT ENVIRONMENT: A REVIEW
N. H. Tran, M. A. Maris, I. L. Kofsky, and E. Murad (Air Force Geophysics Lab., Hanscom AFB, MA.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 159-166 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 20F

N90-25529*# Calspan Field Services, Inc., Arnold AFS, TN. AEDC Operations.
SATELLITE MATERIAL CONTAMINANT OPTICAL PROPERTIES
B. E. Wood, W. T. Bertrand, B. L. Seiber, E. L. Kiech, P. M. Falco, and J. D. Holt (Arnold Engineering Development Center, Arnold Air Force Station, TN.) *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 257-262 Sponsored in part by AF (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 20F

N90-25553*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VISUALIZATION OF THREE DIMENSIONAL DATA
Stephen R. Ellis, Stephen Smith, and Selim Hacisalihzade *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar.

1990 p 465-469 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N90-25677# General Atomic Co., San Diego, CA.
THE BETA LIMIT IN THE DIII-D TOKAMAK
J. R. Ferron, M. S. Chu, F. J. Helton, W. Howl, A. G. Kellman, L. L. Lao, E. A. Lazarus (Oak Ridge National Lab., TN.), J. K. Lee, T. H. Osborne, and R. D. Stambaugh et al Apr. 1990 4 p Presented at the 17th European Conference on Controlled Fusion and Plasma Heating, Amsterdam, Netherlands, 25-29 Jun. 1990 Submitted for publication
(Contract DE-AC03-89ER-51114)
(DE90-011896; GA-A-20063; CONF-900602-11) Avail: NTIS HC A01/MF A01

The combination of high power deuterium neutral beam injection and operation with high current double-null divertor discharges has enabled increasingly high values of both toroidal and normalized beta ((beta)(sub T) and (beta)(sub N) respectively) to be obtained in the DIII-D tokamak. The highest achieved values are (beta)(sub T) = 9.3 percent and (beta)(sub N) = 5 percent-m-T/MA, obtained indifferent discharges. Here, (beta)(sub T) = ((integral)PdV/V)/(B(sup 2)/(mu) (sub 0)) is the volume average beta and (beta)(sub N) = (beta)(sub T)/(I/aB) where a is the minor radius of the discharge, B is the vacuum toroidal magnetic field at the geometric center of the discharge, P is the plasma pressure, V is the discharge volume, and I is the plasma current. It is expected that when the beta reaches a threshold value an ideal instability will occur, either the low toroidal mode number (n) ideal kink mode or the high-n, ideal ballooning mode. If all other obstacles to achieving high values of beta are overcome, it is generally postulated that the insurmountable limit to beta will be the stability threshold of one of these modes. According to Troyon-Sykes scaling, this limit to (beta)(sub N) is a constant (C(sub (beta))) with a value which depends on the limiting ideal instability, plasma profiles, and wall stabilization. Previous tokamak experiments have found operational limits representing C(sub (beta)) values from 2.8 to 3.5, associated with several types of instabilities. Experimental data is presented in this paper that demonstrates that over a wide range of plasma current, in DIII-D the value of C(sub (beta)) is larger than 3.5. DOE

N90-25678# Los Alamos National Lab., NM.
ADVANCES IN SPHEROMAK UNDERSTANDING AND PARAMETERS
J. C. Fernandez 1990 43 p Presented at the 4th Latin American Workshop on Plasma Physics, Buenos Aires, Argentina, 16-27 Jul. 1990
(Contract W-7405-eng-36)
(DE90-012052; LA-UR-90-1820; CONF-900739-1) Avail: NTIS HC A03/MF A01

A spheromak is a toroidally-shaped magnetized plasma configuration in which no material links the torus so that the topology of the spheromak boundary is spherical. The magnetic fields in the plasma are generated by the internal plasma currents. In the period of ten years since the properties of a nearly force-free spheromak configuration were described using single-fluid MHD theory, remarkable theoretical and experimental advances have been made. This paper highlights some of that work. Spheromak not only have been successfully produced in the laboratory using a variety of methods, but also translated, compressed and stably sustained for many resistive-decay times. Spheromak formation, equilibrium and stability to current-driven modes have been successfully modeled by single-fluid MHD coupled with the concepts of magnetic helicity and relaxation toward the minimum-energy force-free state. There is evidence, however, that the relaxation mechanism which drives parallel plasma currents is due to effects beyond the scope of single-fluid resistive MHD. The confinement properties of clean spheromaks have been measured, and shown to be excellent, provided the fraction of open magnetic flux at the edge is decreased sufficiently. In addition to studies directly relating to fusion, the use of spheromaks for other goals is briefly described, including tokamak refueling, radiation production, magnetically-insulted inertially confined fusion, demonstration of helicity injection by mechanical means, and energy storage/transfer to accelerate fast metallic projectiles. DOE

N90-25679# Oak Ridge National Lab., TN.
FORMATION OF MAGNETIC ISLANDS DUE TO FIELD PERTURBATIONS IN TOROIDAL STELLARATORS
Deok Kyo Lee 1990 16 p Presented at the 11th International Science and Technology Symposium, Seoul, Republic of Korea, 25-29 Jun. 1990
(Contract DE-AC05-84OR-21400)
(DE90-012132; CONF-9006194-1) Avail: NTIS HC A03/MF A01

An explicit formulation is developed to determine the width of a magnetic island separatrix generated by magnetic field perturbations in a general toroidal stellarator geometry. A conventional method is employed to recast the analysis in a magnetic flux coordinate system without using any simplifying approximations. The island width is seen to be proportional to the square root of the Fourier harmonic of B(sup rho)/B(sup zeta) that is in resonance with the rational value of the rotational transform, where B(sup rho) and B(sup zeta) are contravariant normal and toroidal components of the perturbed magnetic field, respectively. The procedure, which is based on a representation of three-dimensional flux surfaces by double Fourier series, allows rapid and fairly accurate calculation of the island widths in real vacuum field configurations, without the need to follow field lines through numerical integration of the field line equations. Numerical results of the island width obtained in the flux coordinate representation for the Advanced Toroidal Facility agree closely with those determined from Poincare puncture points obtained by following field lines. DOE

N90-25680# Science Applications International Corp., McLean, VA.
COMPARATIVE ASSESSMENT OF WORLD RESEARCH EFFORTS ON MAGNETIC CONFINEMENT FUSION
R. C. Davidson, R. D. Hazeltine, M. A. Abdou, L. A. Berry, J. T. Hogan, and P. H. Rutherford (Princeton Univ., NJ.) Feb. 1990 206 p Prepared in cooperation with Science Applications International Corp., San Diego, CA
Avail: NTIS HC A10/MF A02

A comparative assessment is presented of the world's four major research efforts on magnetic confinement fusion, which include the capabilities in the Soviet Union, the European Community (Western Europe), Japan, and the United States. A comparative evaluation is provided in six areas: tokamak confinement; alternate confinement approaches; plasma techology and engineering; fusion nuclear technology and materials; plasma confinement theory; and fusion computations. Although the world's four major fusion efforts are roughly comparable in overall capabilities, two conclusions of this report are inescapable. First, the Soviet fusion effort is presently the weakest of the four programs in most areas of the assessment. (Electron cyclotron heating, plasma confinement theory, and mirror research are notable exceptions). Second, if present trends continue, the U.S., once the world leader in fusion research, will soon lose its position of leadership to the West European and Japanese fusion programs. Indeed, before the middle 1990s, the upgraded large-tokamak facilities, JT-60U (Japan) and JET (Western Europe), are likely to explore plasma conditions and operating regimes well beyond the capabilities of the TFTR tokamak (U.S.). In addition, if present trends continue in the areas of fusion nuclear technology and materials, and plasma technology development, the capabilities of Japan and Western Europe in

these areas (both with regard to test facilities and fusion-specific industrial capabilities) will surpass those of the U.S. by a substantial margin before the middle 1990s. Author

N90-25681 Institut d'Aeronomie Spatiale de Belgique, Brussels.
NONLINEAR SUPERSONIC MOTIONS OF MAGNETIZED PLASMA FLOW WITH MASS LOADING
I. K. Khabibrakhmanov and F. Verheest (Ghent Univ., Belgium) 1990 28 p Submitted for publication
(Aeronomica-Acta-A-354-1990; ISSN-0065-3713; ETN-90-97027)
Avail: Institut d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

A kinetic description of magnetized plasma flow with mass loading is developed and leads to a nonlinear wave equation for small scale dispersive magnetosonic plasma motions superimposed on large scale motions due to mass loading. The mass loading can drive quasistationary, finite-amplitude magnetosonic type waves in a supersonic plasma flow, even though small amplitude linear disturbances are damped, but only when the magnetosonic Mach number drops to 2 during the slowing down of the mass loaded plasma flow. Nonlinear motions with constant amplitude could be permanent features of a mass loaded plasma flow, as in the neighborhood of comets and planets with extended atmospheres but negligible magnetic fields. The relation between the wave amplitude and the local magnetosonic Mach number is computed and can easily be compared with in situ measurements in cometary plasma environments. ESA

N90-25101# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Unternehmensbereich Energie- und Industrietechnik.
TECHNOLOGY FOR LOW PRESSURE PLASMA PROCESSES, A NEW APPROACH: THE PLASMA BOX CONCEPT
Achim Bubenzer and Jacques P. M. Schmitt *In its* Research and Development: Technical and Scientific Publications 1989 1989 p 309-312 Presented at the 11th International Vacuum Congress, Cologne, Fed. Republic of Germany, 25-29 Sep. 1989
(For primary document see N90-25075 19-01)
(MBB-UE-0003/89-PUB) Avail: NTIS HC A15/MF A02

N90-25545*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PLASMA INTERACTIONS AND EFFECTS FOR LARGE SYSTEMS
David B. Snyder *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 393-404 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 20I

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N90-25682 Department of the Navy, Washington, DC.
FORMATION OF HIGH Tc SUPERCONDUCTING FILMS BY ORGANOMETALLIC CHEMICAL VAPOR DEPOSITION Patent Application
Alan Berry, inventor (to Navy), David Gaskill, inventor (to Navy), Ronald Holm, inventor (to Navy), and Edward Cukauskas, inventor (to Navy) 16 May 1989 25 p
(AD-D014498; US-Patent-Appl-SN-352325) Avail: HC A03/MF A01 CSCL 05/2

This invention relates to a method of forming high Tc superconducting films by organometallic chemical vapor deposition. More specifically, this invention relates to a method of forming superconducting films on a semiconductor surface by chemical vapor deposition of volatile organometallic compounds of the rare earth and alkaline earth elements, and copper. GRA

N90-25683# Wisconsin Univ., Milwaukee. Dept. of Physics.
SURFACE WAVE CHARACTERIZATION OF HIGH T(SUB c) SUPERCONDUCTORS Final Report, 30 Sep. 1984 - 30 Sep. 1989
26 Mar. 1990 20 p
(Grant AF-AFOSR-0350-84; AF Proj. 2306)
(AD-A221077; AFOSR-90-0481TR) Avail: NTIS HC A03/MF A01 CSCL 09/4

High T(sub c) superconducting controlling elements for frequency tunable surface acoustic wave SAW filters and dispersion lines in the 0.5 to 4 GHz range have been proposed and designed. Ultrasonic attenuation and velocity measurements in sinter forged YBa2Cu3O7 indicate that the sound waves are interacting with excitations which are confined to the CuO planes. Proximity SAW coupling to a two-dimensional electron gas 2 DEG has placed limits on the localization lengths of the 2 DEG. A new phase transition has been ultrasonically discovered in the mixed state of the heavy Fermion superconductor UPt3. An anomalous increase in attenuation in the superconducting state of the reentrant superconductor system Er(1-x)Ho(x)Rh(4)B4 implies a novel interaction mechanism in this system. SAW measurements on granular superconducting films demonstrate that SAW measure the sheet resistivity of these films on a length scale comparable to the SAW wavelength. GRA

N90-25684 Department of the Navy, Washington, DC.
SCANNING ELECTRON MICROSCOPY BY PHOTOVOLTAGE CONTRAST IMAGING Patent
Larry D. Flesner, inventor (to Navy) 20 Feb. 1990 6 p Filed 18 May 1989
(AD-D014517; US-Patent-4,902,967; US-Patent-Appl-SN-353722; US-Patent-Class-324-158) Avail: US Patent and Trademark Office CSCL 14/2

A process and apparatus are disclosed for remotely determining electrical properties of a semiconductor. A surface of the semiconductor is simultaneously irradiated with an electron beam to generate secondary electrons from the irradiated surface and with a modulated light beam. Secondary electrons emitted by the semiconductor are filtered by an electron energy analyzer. An electron detector receives the filtered electrons and provides an output corresponding to electrical properties of the irradiated area. The output is provided to a computer which calculates the difference in output between periods when the semiconductor is being illuminated with the light beam and when it is not so illuminated. The time dependence of the output may also be measured. GRA

N90-25685# Wichita State Univ., KS. Inst. for Aviation Research.
SUITABILITY OF ELECTRODEPOSITION PROCESSES FOR HIGH TEMPERATURE SUPERCONDUCTORS Final Report
James C. Ho Nov. 1989 26 p
(IAR-89-22) Avail: NTIS HC A03/MF A01

Following the discovery of superconducting YBa2Cu3O(7-x) with transition temperatures (T sub c) above the normal boiling point of nitrogen (78 K), a research program was initiated. The feasibility was evaluated of applying an electrophoretic deposition process to such materials. Partial substitution of Sr by Ba in the (BiPb)-Sr-Ca-Cu oxide with anominal 2223-composition effectively suppresses Tc from 106 to about 70 K. It further promotes the formation of a semiconducting phase which coexists with the lower-Tc, 2212-type structure. The fraction of this yet to be identified phase increases with increasing x, and becomes dominate at x above 1.2. The enlarged spacing between the Bi-O and Cu-O planes due to a Ba-substitution may have contributed to this effect. In comparison, a superconducting to semiconducting transition is also well known to occur in YBa2CuO(7-d) compounds at low oxygen content, and the transition is accompanied by a structural change from orthorhombic to tetragonal. Author

N90-25686# Argonne National Lab., IL. Materials and Components Technology Div.
USE OF HIGH-TEMPERATURE SUPERCONDUCTORS IN SUPERCONDUCTING MAGNETIC ENERGY POWER SOURCES
David N. Palmer, John R. Hull, Tuncer M. Kuzay, and Susan M. Schoenung (Schafer, W. J. Associates, Inc., Pleasanton, CA) 1990 21 p Presented at the 34th International Power Sources Symposium, Cherry Hill, NJ, 25-28 Jun. 1990 Sponsored in part by ABB-Combustion Engineering, Inc., Windsor, CT
(Contract W-31-109-eng-38)
(DE90-011119; CONF-9006146-7) Avail: NTIS HC A03/MF A01

The concept of mobile superconducting magnetic energy power sources (SMEPS) is introduced and scrutinized. Use of high temperature superconductors (HTSs) in mobile SMEPS is discussed. Coil scaling and structural-force calculations for small solenoidal and toroidal coil systems are presented, and the efficiency of system refrigeration as a function of mechanical support, insulation, and power lead thermal losses is estimated. Required HTS properties, derived from considerations developed, are compared to properties of presently available materials or those expected to evolve in the near term. Analysis verifies the possibility of using SMEPS for military and nonmilitary mobile energy storage and power backup. The results show that the evolution of SMEPS will be stimulated by the development of higher strength, tougher HTS that can operate at current densities greater than 10(exp 4) A/sq cm in magnetic fields of 4 to 6 T and temperatures of 77 K or higher. Earliest prototype SMEPS may employ coils cooled by liquid helium with HTS power leads or 20 to 30 K cryorefrigerated HTS materials that are engineered to withstand coil stresses during charge and discharge. DOE

N90-25687# Oak Ridge National Lab., TN. Solid State Div.
SUPERCONDUCTIVITY IN NONSYMMETRIC EPITAXIAL YBa2Cu3O(SUB 7-DELTA)-PrBa2Cu3O(SUB 7-DELTA) SUPERLATTICES GROWN BY PULSED LASER ABLATION
Douglas H. Lowndes, David P. Norton, J. D. Budai, S. J. Pennycook, D. K. Christen, B. C. Sales, and R. Feenstra Apr. 1990 7 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC05-84OR-21400)
(DE90-011637; CONF-900466-48) Avail: NTIS HC A02/MF A01

Pulsed KrF (248 nm) excimer laser ablation has been used to grow nonsymmetric epitaxial YBCO/PrBCO superlattices containing 1-, 2-, 3-, 4-, and 8-unit-cell-thick YBCO layers, separated by N-cell-thick insulating PrBCO layers (N = 1 (minus) 16). The 1 (times) N and 2 (times) N structures exhibit a rapid initial decrease of T(sub co) with increasing PrBCO layer thickness, followed by saturation of T(sub co) at a nonzero value, as the YBCO layer's separation is increased further. The limiting T(sub co) values for 1-, 2-, 3-, 4-, and 8-cell-thick YBCO layers isolated in a PrBCO matrix are (approximately) 19 K, (approximately) 54 K, (approximately) 71 K, and (approximately) 87 K , respectively. Single-cell-thick YBCO layers are found to be superconducting even when separated by (approximately) 19 nm in a PrBCO matrix. These results are discussed in terms of possible Josephson and/or proximity effects coupling the YBCO layers, and the possibility that PrBCO modifies the electronic structure and depresses T(sub co) in YBCO cells that are immediately adjacent to the PrBCO layers. Finally, high-temperature post-annealing studies show that these superlattice structures are stable and that little diffusion occurs along the c-axis direction of compositional modulation. DOE

N90-25688# Los Alamos National Lab., NM.
MICROSTRUCTURES OF SUPERCONDUCTING YBa2Cu3O(7-x) THIN FILMS
Soumendra N. Basu, Tapan Roy, Terence E. Mitchell, Ross E. Muenchausen, and Michael Nastasi 1990 10 p Presented at the Conference on the Science and Technology of Thin Film Superconductors, Denver, CO, 30 Apr. - 4 May 1990 Submitted for publication
(Contract W-7405-eng-36)
(DE90-011976; LA-UR-90-1609; CONF-900424-2) Avail: NTIS HC A02/MF A01

The microstructure of YBa(sub 2)Cu(sub 3)O(sub 7-x) thin films grown on (001) SrTiO(sub 3) and LaAlO(sub 3) substrates by electro beam co-evaporation and laser ablation techniques have been examined. Examination of a 15000 A thick film or SrTiO(sub 3) grown by electro beam co-evaporation showed a switchover from c-perpendicular to c-parallel growth at a thickness of around 2000 A. Thinner films (1500 A thick), grown on SrTiO(sub 3) by this technique were found to have a fully c-perpendicular microstructure. However, this required the substrate surface to be not only highly oriented but also microscopically smooth. Formation of surface steps on the substrates due to surface roughness caused c-parallel growth in the films, leading to deterioration of their properties. In contrast, a 5000 A thick film formed by laser ablation on LaAlO(sub 3) was found to have a completely c-perpendicular microstructure. The reasons for the development of these microstructures are discussed. DOE

N90-25689# Fermi National Accelerator Lab., Batavia, IL.
INVESTIGATION OF THE MECHANICAL PROPERTIES OF SUPERCONDUCTING COILS
F. W. Markely and J. S. Kerby Mar. 1990 11 p Presented at the 2nd International Industrial Symposium on the Super Collider, Miami, FL, 14-16 Mar.1990
(Contract DE-AC02-76CH-03000)
(DE90-012020; FNAL-TM-1660; CONF-900348-9) Avail: NTIS HC A03/MF A01

This paper presents data on 3 of the important mechanical properties of superconducting super collider (SSC) type superconducting coils. The measured properties are: (1) the azimuthal elastic modulus of the coil samples made for the stress relaxation tests; (2) the rate of stress relaxation of collared SSC outer coils molded to different sizes; and (3) the pressures that various insulations can withstand during molding or collaring before turn-to-turn shorts develop. Additional data on these and other properties are available but omitted here because of space limitations. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N90-25690*# Fermi National Accelerator Lab., Batavia, IL.
IDENTIFYING DECOHERING PATHS IN CLOSED QUANTUM SYSTEMS
Andreas Albrecht 28 Jun. 1990 40 p
(Grant NAGw-1340)
(NASA-CR-182853; NAS 1.26:182853; FERMILAB-Pub-90/128-A)
Avail: NTIS HC A03/MF A01 CSCL 20C

A specific proposal is discussed for how to identify decohering paths in a wavefunction of the universe. The emphasis is on determining the correlations among subsystems and then considering how these correlations evolve. The proposal is similar to earlier ideas of Schroedinger and of Zeh, but in other ways it is closer to the decoherence functional of Griffiths, Omnes, and Gell-Mann and Hartle. There are interesting differences with each of these which are discussed. Once a given coarse-graining is chosen, the candidate paths are fixed in this scheme, and a single well defined number measures the degree of decoherence for each path. The normal probability sum rules are exactly obeyed (instantaneously) by these paths regardless of the level of decoherence. Also briefly discussed is how one might quantify some other aspects of classicality. The important role that concrete calculations play in testing this and other proposals is stressed.
Author

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N90-25691# Wichita State Univ., KS. Inst. for Aviation Research.
A TREND ANALYSIS OF WOMEN WHO HOLD FEDERAL AVIATION ADMINISTRATION CERTIFICATES: RELATIONSHIP TO THE REPRESENTATION OF WOMEN IN COLLEGIATE AVIATION FACULTY RANKS
Brent D. Bowen Mar. 1990 17 p
(IAR-90-3) Avail: NTIS HC A03/MF A01

Data on FAA certificate holders is analyzed and compared to data obtained on aviation faculty in higher education to establish whether or not women are under represented in the collegiate aviation faculty. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N90-25692*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
TOOLS FOR DISTRIBUTED APPLICATION MANAGEMENT
Keith Marzullo, Mark Wood, Robert Cooper, and Kenneth P. Birman 1990 30 p
(Grant NAG2-593)
(NASA-CR-186646; NAS 1.26:186646) Avail: NTIS HC A03/MF A01 CSCL 05A

Distributed application management consists of monitoring and controlling an application as it executes in a distributed environment. It encompasses such activities as configuration, initialization, performance monitoring, resource scheduling, and failure response. The Meta system is described: a collection of tools for constructing distributed application management software. Meta provides the mechanism, while the programmer specifies the policy for application management. The policy is manifested as a control program which is a soft real time reactive program. The underlying application is instrumented with a variety of built-in and user defined sensors and actuators. These define the interface between the control program and the application. The control program also has access to a database describing the structure of the application and the characteristics of its environment. Some of the more difficult problems for application management occur when pre-existing, nondistributed programs are integrated into a distributed application for which they may not have been intended. Meta allows management functions to be retrofitted to such programs with a minimum of effort. Author

N90-25693# Nijmegen Univ. (Netherlands). Dept. of Information Systems.
CONCEPTUAL TASK MODELING
A. H. M. terHofstede and S. Brinkkemper (Software Engineering Research Centre, Utrecht, Netherlands) Sep. 1989 69 p
(TR-89-14; ETN-90-96885) Avail: NTIS HC A04/MF A01

A conceptual specification technique for the process parts of business activities is developed. This technique, called Conceptual Task Model (CTM) is based on predicate/transition nets. A formal definition of the CTM is given and some properties of the CTM are stated. Related aspects such as automated code generation, opportunities for reverse engineering, and adaptation of the CTM technique to a CASE-tool are discussed. The computational power of CTM is investigated. The relation between business activities and tasks is formally described and the relation between task model, interaction model and even model is examined. ESA

N90-25694# Nijmegen Univ. (Netherlands). Dept. of Information Systems.
THE CONCEPTUAL TASK MODEL: A SPECIFICATION TECHNIQUE BETWEEN REQUIREMENTS ENGINEERING AND PROGRAM DEVELOPMENT
S. Brinkkemper and A. H. M. terHofstede (Software Engineering Research Centre, Utrecht, Netherlands) Sep. 1989 20 p
(TR-89-15; ETN-90-96886) Avail: NTIS HC A03/MF A01

A specification technique called the Conceptual Task Model (CTM) is introduced. It is designed to bridge the gap between the informal requirements of engineering activities and the more formal program development stages. The CTM is related explicitly to the results of the global requirements specification, i.e., process models and data models that can be input to code generation. The CTM technique is based on and defined in terms of Predicatetransition nets. CTM integrates the specifications of the data manipulation function with control structures and local and global data models. The precise relation between the process model and some other theoretical issues is discussed. ESA

N90-25695*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TECHNICAL GUIDE ON DOCUMENTATION REQUIREMENTS FOR OPEN MARKET CONTRACT ACQUISITIONS OF INFORMATION RESOURCES
Asa L. Shaw, Jr., William R. Kivett, and James Y. Taylor Jun. 1990 36 p
(NASA-TM-102650; NAS 1.15:102650) Avail: NTIS HC A03/MF A01 CSCL 05A

A guide is presented to assist requestors in formulating and submitting the required Complete Package for Information Resources (IR) acquisitions. Advance discussions with cognizant procurement personnel are strongly recommended for complex IR requirements or for those requestors new to the acquisition process. Open Market means the requirement either is not available on GSA Schedule Contract or exceeds the $300,000 threshold and/or the quantity Maximum Order Limitation of the GSA Schedule Contract. Only open market contract acquisitions (i.e., in excess of the $25,000 small purchase threshold), are addressed. Author

N90-25562*# Ford Aerospace and Communications Corp., Sunnyvale, CA.
OMS FDIR: INITIAL PROTOTYPING
Eric W. Taylor and Matthew A. Hanson *In* NASA, Lyndon B. Johnson Space Center, Third Annual Workshop on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 545-549 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N90-25696*# Cornell Univ., Ithaca, NY.
RELIABLE BROADCAST PROTOCOLS
T. A. Joseph and Kenneth P. Birman [1989] 26 p
(Grant NAG2-593)
(NASA-CR-186411; NAS 1.26:186411) Avail: NTIS HC A03/MF A01 CSCL 05B

A number of broadcast protocols that are reliable subject to a variety of ordering and delivery guarantees are considered. Developing applications that are distributed over a number of sites and/or must tolerate the failures of some of them becomes a considerably simpler task when such protocols are available for communication. Without such protocols the kinds of distributed applications that can reasonably be built will have a very limited scope. As the trend towards distribution and decentralization continues, it will not be surprising if reliable broadcast protocols have the same role in distributed operating systems of the future that message passing mechanisms have in the operating systems of today. On the other hand, the problems of engineering such a system remain large. For example, deciding which protocol is the

most appropriate to use in a certain situation or how to balance the latency-communication-storage costs is not an easy question. Author

N90-25697# Wichita State Univ., KS. Inst. for Aviation Research.
PROGRAM PLAN: INTERNATIONAL AIRCRAFT OPERATOR DATA BASE Report, Jan. 1990
John J. Hutchinson and Frank Macheers Dec. 1989 14 p
(Contract DTFA03-89-C-00057)
(IAR-90-1; DOT/FAA/CT-89/34) Avail: NTIS HC A03/MF A01

This Program Plan describes studies and research which will result in a Master Requirements and Implementation Plan for the creation of an international data base of all operators of United States type-certificated aircraft. This Master Plan assesses the FAA's requirements concerning the availability, acquisition, and development of international aircraft operator data. Efforts involve identifying problem areas and information gaps, and recommending solutions or options. The Master Plan begins with a determination of the FAA's needs for aircraft operator data and concludes with recommendations of data base development. These are directed toward meeting the requirement to distribute airworthiness safety information to aircraft operators in a cost effective manner using an automated, menu driven, filing and retrieval system. Author

N90-25698* National Aeronautics and Space Administration, Washington, DC.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 1: ABSTRACTS (SUPPLEMENT 37)
Jan. 1989 43 p
(NASA-SP-7039(37)-Sect-1; NAS 1.21:7039(37)-Sect-1) Avail: NTIS HC A04; NTIS standing order as PB89-911100, $15.00 domestic, $30.00 foreign CSCL 05B

Abstracts are provided for 76 patents and patent applications entered into the NASA scientific and technical information systems during the period January 1990 through June 1990. Each entry consists of a citation, an abstract, and in most cases, a key illustration selected from the patent or patent application. Author

N90-25699# Pacific Northwest Lab., Richland, WA.
OBJECT-ORIENTED DESIGN: DERIVING CONCEPTUAL SOLUTIONS TO LARGE-SCALE INFORMATION PROCESSING PROBLEMS
M. A. Whiting May 1990 22 p
(Contract DE-AC06-76RL-01830)
(DE90-011189; PNL-7279) Avail: NTIS HC A03/MF A01

The Vertical Integration of Science, Technology, and Applications (VISTA) Project is a long-term effort conducted by the Pacific Northwest Laboratory (PNL) directed toward accelerating the process of making research results (data, models, advanced concepts) usable and available to R and D applications. The initial goal of the program is to develop a software-based information system to guide the assessment and remediation process for hazardous waste sites at the U.S. Department of Energy (DOE) facilities. The information system will link users (DOE, laboratories, and remediation contractors) to computer models and technical data available at PNL, to speed up the remediation process, while decreasing costs and accelerating the deployment of new technologies. This report describes a methodology used to design components of the VISTA information system based on an object-oriented computing model. DOE

N90-25700# California Univ., Berkeley. Lawrence Berkeley Lab.
A FRAMEWORK FOR QUERY OPTIMIZATION IN TEMPORAL DATABASES
Himawan Gunadhi and Arie Segev Nov. 1989 20 p Presented at the 5th International Conference on Statistical and Scientific Database Management, Charlotte, NC, 3-5 Apr. 1990 Revised
Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098)
(DE90-011339; LBL-26417; CONF-9004206-1) Avail: NTIS HC A03/MF A01

Issues were investigated to query processing of temporal databases in a relational environment. Tuple-versioning of relations is the adopted method of temporal data representation. New operators are necessary in order to exploit the richer semantics of temporal queries. We define four types of temporal joins--theta-join, time intersection, time union and the event-join. Factors that affect processing strategies are discussed, especially the problem of estimating data selectivity for various temporal operations. Strategies for implementing the temporal equijoin operator are evaluated. DOE

N90-25701# EG and G Mound Applied Technologies, Miamisburg, OH.
APPLICATIONS OF PC-BASED DIGITAL IMAGING FOR STORING MICROSCOPY IMAGES ON OPTICAL DISKS
Patrick M. Schleitweiler and Mark H. Ransick 1990 12 p Presented at the Advances in Video Technology: Material Science Applications, San Francisco, CA, 23-25 May 1990
(Contract DE-AC04-88DP-43495)
(DE90-011355; MLM-3636(OP); CONF-9005206-1) Avail: NTIS HC A03/MF A01

Advances in video technology and digital imaging have resulted in the ability to produce an image in a high quality digital format. Images that are created and viewed in a digital format can not only be quantitatively measured but can also be stored to disk for later examination. Write-once read many (WORM) optical disks are excellent media for archiving digital images. Several applications are discussed. All of the applications use a PC-based system for storing and recalling images on optical disks. These applications include metallographs, specialized microscopes, and scanning electron microscopes. DOE

N90-25702*# Dartmouth Coll., Hanover, NH. Dept. of Mathematics and Computer Science.
THEFT OF INFORMATION IN THE TAKE-GRANT PROTECTION MODEL
Matt Bishop [1989] 45 p Revised
(Grant NAG2-480)
(NASA-CR-186638; NAS 1.26:186638; PCS-TR88-137-Rev)
Avail: NTIS HC A03/MF A01 CSCL 05B

Questions of information flow are in many ways more important than questions of access control, because the goal of many security policies is to thwart the unauthorized release of information, not merely the illicit obtaining of access rights to that information. The Take-Grant Protection Model is a theoretical tool for examining such issues because conditions necessary and sufficient for information to flow between two objects, and for rights to objects to be obtained or stolen, are known. These results are extended by examining the question of information flow from an object the owner of which is unwilling to release that information. Necessary and sufficient conditions for such theft of information to occur are derived, and bounds on the number of subjects that must take action for the theft to occur are presented. To emphasize the usefulness of these results, the security policies of complete isolation, transfer of rights with the cooperation of an owner, and transfer of information (but not rights) with the cooperation of the owner are presented; the last is used to model a simple reference monitor guarding a resource. Author

N90-25703# Sandia National Labs., Albuquerque, NM. Statistics, Computing, and Human Factors Div.
A HUMAN FACTORS REVIEW OF DATA ENTRY DEVICES
Heather W. Allen Jun. 1990 36 p
(Contract DE-AC04-76DP-00789)
(DE90-012009; SAND-90-0795) Avail: NTIS HC A03/MF A01

This report provides system designers with basic human factors information and guidelines to help in the selection of manual data input devices. The selection of such devices is important with respect to the environment in which the device with be used, speed of data entry required, error potential, and the user friendliness of the candidate devices. The report reviews several of the most commonly used data input devices and provides a description of each, experimental evaluations, and observations

and recommendations based on review of the data. In addition, the appendix presents an input device matrix that gives general guidance concerning input devices and the physical and mission environment in which they might be used. Additional assistance should be requested from Sandia National Laboratories (SNL) Human Factors Personnel. DOE

N90-25704*# National Aeronautics and Space Administration, Washington, DC.
NASA'S EXPERIENCE IN THE INTERNATIONAL EXCHANGE OF SCIENTIFIC AND TECHNICAL INFORMATION IN THE AEROSPACE FIELD
Philip A. Thibideau Apr. 1990 11 p Presented at the Annual Meeting of the German Society for Aeronautics and Astronautics (DGLR), Hamburg, Fed. Republic of Germany, 2-4 Oct. 1989 Previously announced in IAA as A90-22700
(NASA-TM-103093; NAS 1.15:103093) Avail: NTIS HC A03/MF A01 CSCL 05B

The early NASA international scientific and technical information exchange arrangements were usually detailed in correspondence with the librarians of the institutions involved. While this type of exchange grew to include some 200 organizations in 43 countries, NASA's main focus shifted to the relationship with the European Space Agency (ESA), which began in 1964. The NASA/ESA Tripartite Exchange Program provides more than 4000 technical reports from the NASA-produced Aerospace Database. The experience in the evolving cooperation between NASA and ESA has established the model for more recent exchange agreements with Israel, Australia, and Canada. The results of these agreements are made available to participating European organizations through the NASA File. Author

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N90-25705*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ESTIMATING THE COST OF MAJOR ONGOING COST PLUS HARDWARE DEVELOPMENT PROGRAMS
J. C. Bush Jun. 1990 33 p
(NASA-TM-100401; NAS 1.15:100401) Avail: NTIS HC A03/MF A01 CSCL 05C

Approaches are developed for forecasting the cost of major hardware development programs while these programs are in the design and development C/D phase. Three approaches are developed: a schedule assessment technique for bottom-line summary cost estimation, a detailed cost estimation approach, and an intermediate cost element analysis procedure. The schedule assessment technique was developed using historical cost/schedule performance data. Author

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N90-25706# General Accounting Office, Washington, DC. Resources, Community, and Economic Development Div.
TECHNOLOGY TRANSFER: US AND FOREIGN PARTICIPATION IN R AND D AT FEDERAL LABORATORIES
Briefing report to the Honorable Lloyd Bentsen, US Senate
Aug. 1988 77 p
(GAO/RCED-88-203BR; B-221997) Avail: NTIS HC A05/MF A01

The principal mechanism for non-Federal U.S. and foreign participation in Federal research and development (R and D) laboratories is through programs that bring in researchers from outside organizations to work for 6 months to 1 year. To obtain information about the extent of this participation, and the laboratories' policies regarding foreign access, a questionnaire was sent to 52 laboratories in 7 Federal agencies, which were selected with the assistance of agency officials. Fifty laboratories responded. They employed 43,902 researchers and had a total R and D operating budget of over 50 percent of the budget for Federal laboratories for fiscal year 1986. Foreigners comprised 30 percent of their outside researchers. Eight laboratories whose research and development results could have important commercial applications were visited. In general, the Federal laboratories support open exchanges in areas of basic research, but have restrictions on foreign access to technologies with commercial potential. Managers at the visited sites stated that their researchers have not had difficulty getting access to foreign laboratories and that, except for some isolated instances, foreign researchers have readily exchanged information with Federal laboratory researchers. This report provides background information and more details about the study's objectives, scope, and methodology, information about the extent of U.S. and foreign participation, Federal laboratories' policies, reciprocity in the exchange of information, and the implications of these issues for U.S. policy on foreign access. The research managers and administrators did not perceive a need for additional guidance or authority regarding foreign access to the Federal laboratories. J.P.S.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N90-25707# General Accounting Office, Washington, DC. Resources, Community, and Economic Development Div.
TECHNOLOGY TRANSFER: IMPLEMENTATION STATUS OF THE FEDERAL TECHNOLOGY TRANSFER ACT OF 1986. REPORT TO CONGRESSIONAL REQUESTERS
May 1989 52 p
(GAO/RCED-89-154) Avail: NTIS HC A04/MF A01

The implementation of the Federal Technology Transfer Act of 1986 is examined. Technology transfer is the movement of federally owned or originated technology from one organization, area, or purpose to another. The act promotes technology transfer from Federal laboratories primarily by permitting Federal agencies to delegate authority to government-operated laboratories to enter into cooperative research and development agreements with entities in both the public and private sector and by providing Federal employees incentives to promote technology transfer. Information was obtained from 12 Federal agencies and 25 of their laboratories. Key aspects examined included the agencies' delegation of authority to laboratories to enter into cooperative research and development agreements, the number of such agreements entered into, incentives provided to government employees to promote technology transfer, and the status of reports mandated by the act. As of February 1989, the agencies contacted had entered into a total of 172 agreements under the 1986 act, in addition to agreements some agencies continued to enter into under their respective authorizing acts. Each agency either had distributed or planned to distribute to Federal inventors at least 15 percent of royalties collected. One agency had established a new technology transfer cash awards program. The Department of Commerce has drafted its first, mandated, biennial report on the extent to which Federal agencies have implemented the 1986 act. Each agency with government-operated laboratories is in compliance with its required annual reporting to Congress on technology transfer activities conducted under the act. Because technology transfer activities are hard to evaluate when they are defined differently, reporting criteria are being developed. J.P.S.

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N90-25708*# Smithsonian Astrophysical Observatory, Cambridge, MA.
SMALL HELIUM-COOLED INFRARED TELESCOPE EXPERIMENT FOR SPACELAB-2 (IRT) Final Report, 3 Oct. 1977 - 31 Dec. 1988
Giovanni G. Fazio Mar. 1990 170 p
(Contract NAS8-32845)
(NASA-CR-183983; NAS 1.26:183983) Avail: NTIS HC A08/MF A01 CSCL 03A

The Infrared Telescope (IRT) experiment, flown on Spacelab-2, was used to make infrared measurements between 2 and 120 microns. The objectives were multidisciplinary in nature with astrophysical goals of mapping the diffuse cosmic emission and extended infrared sources and technical goals of measuring the induced Shuttle environment, studying properties of superfluid helium in space, and testing various infrared telescope system designs. Astrophysically, new data were obtained on the structure of the Galaxy at near-infrared wavelengths. A summary of the large scale diffuse near-infrared observations of the Galaxy by the IRT is presented, as well as a summary of the preliminary results obtained from this data on the structure of the galactic disk and bulge. The importance of combining CO and near-infrared maps of similar resolution to determine a 3-D model of galactic extinction is demonstrated. The IRT data are used, in conjunction with a proposed galactic model, to make preliminary measurements of the global scale parameters of the Galaxy. During the mission substantial amounts of data were obtained concerning the induced Shuttle environment. An experiment was also performed to measure spacecraft glow in the IR. Author

N90-25709*# Texas Univ., Austin.
DESIGN OF A LUNAR FARSIDE OBSERVATORY Final Report
13 Dec. 1989 107 p
(Contract NASw-4435)
(NASA-CR-186671; NAS 1.26:186671) Avail: NTIS HC A06/MF A01 CSCL 03A

The design of a mantendable lunar farside observatory and science base is presented. A farside observatory will allow high accuracy astronomical observations, as well as the opportunity to perform geological and low gravity studies on the Moon. The requirements of the observatory and its support facilities are determined, and a preliminary timeline for the project development is presented. The primary areas of investigation include observatory equipment, communications, habitation, and surface operations. Each area was investigated to determine the available options, and each option was evaluated to determine the advantages and disadvantages. The options selected for incorporation into the design of the farside base are presented. The observatory equipment deemed most suitable for placement on the lunar farside consist of large optical and radio arrays and seismic equipment. A communications system consisting of a temporary satellite about the L sub 2 libration point and followed by a satellite at the stable L sub 5 libration point was selected. A space station common module was found to be the most practical option for housing the astronauts at the base. Finally, a support system based upon robotic construction vehicles and the use of lunar materials was determined to be a necessary component of the base. Author

N90-25710# California Univ., Berkeley. Lawrence Berkeley Lab. Nuclear Science Div.
FAST PULSARS, STRANGE STARS
N. K. Glendenning Feb. 1990 5 p Presented at the 6th Workshop on Nuclear Dynamics, Jackson Hole, WY, 17-24 Feb. 1990
(Contract DE-AC03-76SF-00098)
(DE90-011631; LBL-28680; CONF-900295-5) Avail: NTIS HC A01/MF A01

The initial motivation for this work was the reported discovery in January 1989 of a 1/2 millisecond pulsar in the remnant of the spectacular supernova, 1987A. The status of this discovery has come into grave doubt as of data taken by the same group in February, 1990. At this time researchers must consider that the millisecond signal does not belong to the pulsar. The existence of a neutron star in remnant of the supernova is suspected because of recent observations on the light curve of the remnant, and of course by the neutrino burst that announced the supernova. However its frequency is unknown. A strong case can be made that a pulsar rotation period of about 1 ms divides those that can be understood quite comfortably as neutron stars, and those that cannot. It will soon be discovered as to whether there is an invisible boundary below which pulsar periods do not fall, in which case, all are presumable neutron stars, or whether there exist sub-millisecond pulsars, which almost certainly cannot be neutron stars. Their most plausible structure is that of a self-bound star, a strange-quark-matter star. The existence of such stars would imply that the ground state of the strong interaction is not, as researchers usually assume, hadronic matter, but rather strange quark matter. Researchers look respectively at stars that are bound only by gravity, and hypothetical stars that are self-bound, for which gravity is so to speak, icing on the cake. DOE

N90-25711# European Space Agency, Paris (France).
THE 23RD ESLAB SYMPOSIUM ON TWO TOPICS IN X RAY ASTRONOMY. VOLUME 1: X RAY BINARIES
James J. Hunt, ed. and Bruce T. Battrick, ed. Nov. 1989 653 p Symposium held in Bologna, Italy, 13-20 Sep. 1989
(ESA-SP-296-Vol-1; ISBN-92-9092-026-2; ISSN-0379-6566; ETN-90-96974) Copyright Avail: NTIS HC A99/MF E06; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The contributions to the 23rd ESLAB Symposium concerning X-ray binaries are presented. The following topics are examined: black hole candidates, Be/X-ray binaries, stellar mass accretion, X-ray pulsars, X-ray triple star systems, accretion disks, low mass X-ray binaries, gamma-ray bursts, quasi-periodic oscillations, observation of galactic X-ray sources, noise spectra and variability, supernova remnants, white dwarf stars, stellar models, plasma oscillations, stellar physics. The observations performed by EXOSAT, Ginga, Mir Space Station, HEAO-1, and IUE are discussed. For individual titles, see N90-25712 through N90-25838.

N90-25712# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
BLACK HOLES IN X RAY BINARIES: X RAY PROPERTIES OF THE GALACTIC BLACK HOLE CANDIDATES
Y. Tanaka *In* ESA, The 23rd ESLAB Symposi..m on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 3-13 (For primary document see N90-25711 19-89)
Copyright Avail: NTIS HC A99/MF E06; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

X-ray properties of the galactic black hole candidates are reviewed. Those properties, previously considered as possible black hole signatures, are reassessed in the light of the recent results. Two bright transients recently discovered from Ginga exhibit unique X-ray properties. Their characteristics are studied as a function of accretion rate. The results suggest that these sources are new black hole candidates. Similarities in the spectral characteristics between the galactic black hole candidates and AGN's are discussed. ESA

N90-25713# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
THE X RAY SPECTRUM OF NOVA VUL 1988. MIR-KVANT DATA
V. V. Efremov, S. A. Grebenev, A. S. Kaniovsky, A. V. Kuznetsov, I. Y. Lapshov, Rashid A. Sunyaev, A. Smith, Arvind N. Parmar, S. Doebereiner, and J. Englhauser et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 15-17 Prepared in cooperation with ESA/ESTEC, Noordwijk, Netherlands; Max-Planck Inst. fuer Physik und Astrophysik, Garching, Fed. Republic of Germany; and Tuebingen Univ., Fed. Republic of Germany (For primary document see N90-25711 19-89)
Copyright Avail: NTIS HC A99/MF E06; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The X-ray spectrum of the two components, detected in Vulpeca GS 2000+25, are presented. Two components of X-ray spectrum were detected: a soft component with a temperature of 20 million Kelvin and a hard component up to the energy 200 to 300 keV. Soft component dominates in the 4 to 15 keV band and contains 90 percent of the source luminosity. ESA

N90-25714# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). EXOSAT Observatory.
IRON K-SHELL LINES FROM RELATIVISTIC ACCRETION DISKS
Luigi Stella (Rome Univ., Italy) *In its* The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 19-23 (For primary document see N90-25711 19-89)
Copyright Avail: NTIS HC A99/MF E06; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

Broad Fe K-shell emission lines at approximately 6 to 7 keV are observed in bright accreting galactic X-ray sources. In the case of the black hole candidates Cyg X-1 and 4U1543-47 the line centroid energy indicates a redshift. The observed widths and redshifts are unlikely to arise from Comptonization. The iron K-line profile is most likely dominated by bulk plasma motions in the vicinity of the accreting collapsed object. A relativistic model for the emission-line profile produced by Keplerian disk orbiting a Schwarzschild black hole is presented. The model predictions are in good agreement with the low resolution lines profiles obtained. The accretion disk scenario outlined can be confirmed by higher resolution studies of the Fe K-lines properties; the mass of the central object and the properties of the accretion flow can be determined. ESA

N90-25715# University of Western Ontario, London. Dept. of Astronomy.
Be/X RAY BINARIES
L. B. F. M. Waters *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 25-30 Sponsored in part by a CITA National Fellowship (For primary document see N90-25711 19-89)
Copyright Avail: NTIS HC A99/MF E06; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The X-ray behavior of Be/X-ray binaries is discussed. The structure of the stellar winds of the Be stars is considered. It is shown that the X-ray luminosities can be understood if the neutron star is embedded in a slowly expanding, dense equatorial wind. The presence of such a wind can be inferred from the H alpha emission and the IR excess. The shapes of the X-ray light curves are interpreted. Large orbital modulations of the X-ray luminosity are caused by orbital motion in a wind with an outflow velocity much larger than the orbital velocity of the neutron star. Small orbital modulations result from outflow velocities that are smaller than the orbital velocity of the neutron star. The distribution of Be/X-ray binaries in the orbital versus spin period diagram can be explained. The possibility of detecting Be+white dwarf systems in X-rays is briefly discussed, and some candidate systems are given. ESA

N90-25716# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). EXOSAT Observatory.
THE X RAY ABSORPTION SPECTRA OF MASSIVE X RAY BINARIES
Frank Haberl *In its* The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 31-37 (For primary document see N90-25711 19-89)
Copyright Avail: NTIS HC A99/MF E06; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

Spectral variations in EXOSAT spectra from high mass X-ray binaries are discussed. An observation of the 4U1700-37/HD153919 system of almost one complete binary cycle of 3.41 days showed a sharp increase in absorption at binary phase 0.6. This increase can be modeled as due to a gas stream from the primary trailing the neutron star. The EXOSAT observations of Vela X-1 (4U0900-40/HD 77581) reveal sharp changes in the absorbing column density on top of a more gradual increase between eclipse egress and ingress of the X-ray source. The higher absorption after superior conjunction of the X-ray source indicates the presence of a dense gas stream similar to the one in the 4U1700-37/HD 153919 system. Spectra from 4U1700-37 taken near the peak intensity of flares around phase 0.5 and spectra from Vela X-1 at early orbital phase show an excess of N sub H at energies lower than 3 keV over that expected from a cold absorber. This excess can be modeled with absorption by ionized gas around the X-rays source. A much larger low energy excess is present at later phases where the N(sub H) is higher and can be explained by scattered X-rays. ESA

N90-25717# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
SPECTRAL VARIABILITY OF LMC X-4
Konrad Dennerl *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 39-44 (For primary document see N90-25711 19-89)
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According to EXOSAT observations the mean spectrum of LMC X-4 during the on state is characterized by a hard power low with a high energy cut-off, a soft energy excess, and an iron emission line. During a very bright flare the spectrum was found to change to thermal bremsstrahlung, which coincides with the spectrum observed outside the flare for energies above the cutoff energy. The existence of two iron lines which change their separation with pulse phase and with the intensity of the continuum is revealed. The behavior is consistent with the assumption of symmetrical Doppler shifting. During other flares instantaneous phase shifts were detected. The consequences of these observations are discussed and compared to the situation in Her X-1. ESA

N90-25718# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
GINGA OBSERVATIONS OF X RAY PULSARS
Fumiaki Nagase *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 45-55 (For primary document see N90-25711 19-89)
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Data from Ginga observations of X-ray pulsars is discussed. They include the detection of a finite rate of change of the orbital period in Her X-1, the determination of the braking index of PSR 0540-69 from X-ray pulse timing, the discoveries of new transient X-ray pulsars, the detection of cyclotron line features from Her X-1, 4U 1538-52, V 0332+53 and possibly 1E 2259+586, and the detection of quasi-periodic oscillations phenomena from two X-ray pulsars, Cen X-3 and 4U 1626-67. The detailed investigation of circumstellar matter surrounding the X-ray binary pulsars, through the analysis of energy spectra in the low intensity states, can be performed. ESA

N90-25719# Consiglio Nazionale delle Ricerche, Bologna (Italy). Inst. TE.S.R.E.
THE HIGH-ENERGY PROPERTIES OF X RAY PULSARS
Filippo Frontera and Daniele DalFiume (Ferrara Univ., Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 57-69 (For primary document see N90-25711 19-89)
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The properties of X-ray pulsars in hard X-rays are reviewed. The presence in the X-ray spectra of lines, probably due to the presence of superstrong magnetic fields, is revealed. The high energy band X-ray pulsars have much simpler pulse profiles and the modulation index shows a general trend to increase. The spectra show great variations in hardness from source to source. The analysis suggests that the harder sources are those with the most intense magnetic fields. The results obtained from pulse-phase spectroscopy and from temporal analysis of aperiodic variations in the flux at high energies are reviewed. ESA

N90-25720# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
OBSERVATIONS OF THE X RAY PULSARS FROM THE KVANT MODULE
M. R. Gilfanov, Rashid A. Sunyaev, E. Churazov, V. Loznikov, V. V. Efremov, A. Kaniovskiy, A. V. Kuznetsov, N. Yamburenko, A. Melioranskiy, and G. K. Skinner et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 71-79 Prepared in cooperation with Utrecht State Univ., Netherlands; Birmingham Univ., England; Max-Planck Inst. fuer Physik und Astrophysik, Garching, Fed. Republic of Germany; Tuebingen Univ., Fed. Republic of Germany; ESA/ESTEC, Noordwijk, Netherlands (For primary document see N90-25711 19-89)
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The results of observations of the following X-ray pulsars are discussed: Cen X-3, SMCX-1, Her X-1, Vela X-1, A0535+26, 4U 1626-67 and GX 1+4. The observations were performed by the instruments onboard Kvant module from 1987 to 1989. The pulsation period measurements are presented and the values of the periods are reduced to the solar system baricenter and (except in the case of A0535+26 and 4U 1626-67) to the binary system baricenter. ESA

N90-25721# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). EXOSAT Observatory.
QPOS AND PREFERRED TIME SCALES IN THE VARIABILITY OF X RAY PULSARS
Lorella Angelini *In its* The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 81-87 (For primary document see N90-25711 19-89)
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Fourier analysis techniques are applied to investigate the noise variability of two X-ray pulsars observed with EXOSAT, EXO 2030+375 and SMC X-1. In the power spectra of EXO 2030+375 a peak was detected and interpreted as due to Quasi-Periodic Oscillations (QPOs). The observed QPOs strength, frequency and frequency-luminosity dependence are in agreement with the predictions of the beat frequency model for QPOs. In the power spectra of SMC X-1 a highly significant turnover for frequencies lower than 0.01 Hz is present. This indicates a preferred time scale of approximately 100 seconds in the source variability. A single burst-like event lasting approximately 80 seconds is probably a manifestation of the source activity on this sort of time scale. ESA

N90-25722# California Univ., Berkeley. Dept. of Astronomy.
TIME-DEPENDENT TWO DIMENSIONAL RADIATION HYDRODYNAMICS OF ACCRETING MATTER ONTO HIGHLY MAGNETIZED NEUTRON STARS
Richard I. Klein and Jonathan Arons (Commissariat a l'Energie Atomique, Saclay, France) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 89-98 (For primary document see N90-25711 19-89)
(Contract W-7405-eng-48; NSF AST-86-15816)
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The self-consistent solution of the two dimensional, time dependent equations of radiation hydrodynamics governing the accretion of matter onto the highly magnetized polar caps of luminous X-ray pulsars is presented. The calculations show a structure in the accretion column very different from previous one zone uniform models. The relevant magnetic field corrections to both the hydrodynamics and the radiative transport are included. A new theory for the diffusion and advection of both radiation energy density and photon number density is presented. For initially uniformly accreting models with super-Eddington flows, evidence of strong radiation-driven outflowing optically thin radiation filled regions of the accretion column embedded in optically-thick inflowing plasma is found. The development of these photon bubbles have growth times on the order of a millisecond and show fluctuations on sub-millisecond timescales. The photon bubbles are likely to be a consequence of convective overstability and may result in observable fluctuations in the emitted luminosity leading to luminosity dependent changes in the pulse profile. ESA

N90-25723# Nagoya Univ. (Japan). Dept. of Astrophysics.
AN X RAY PULSAR IN THE DARK CLOUD LYNDS 1457
Katsuji Koyama *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 99-10 (For primary document see N90-25711 19-89)
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An X-ray pulsar was discovered in the center of the dark cloud Lynds 1457. The nature of the X-ray pulsar is discussed. It is a binary X-ray pulsar or a collapse star in the dense gas. The age of the dark cloud is estimated to be about 100,000 years, the presence of a neutron star or white dwarf in the dark cloud is discussed. ESA

N90-25724# Royal Greenwich Observatory, Hailsham (England).
THE BRIGHT X RAY TRANSIENT GS2023+338 (=V404 CYG) IN OPTICAL OUTBURST AND DECLINE
P. A. Charles, J. Casares, D. H. P. Jones, T. Broadhurst, P. J. Callanan, D. Carter, P. Hacking, B. J. M. Hassall, A. Lawrence, and T. Naylor (Cambridge Univ., England) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 103-107 (For primary document see N90-25711 19-89)
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The results of optical spectroscopy and photometry from La Palma (Canary Islands) of V404 Cyg are presented. They correspond to the optical counterpart of the new X-ray transient GS2023+338 discovered by Ginga. The overall light curve is similar to that of the previous optical outburst of this object, recorded as Nova Cyg 1938 and classified as a classical nova. It is not a classical or recurrent nova. The large range in optical brightness and intense X-ray emission at maximum indicate that the system must be a low-mass X-ray binary. The optical spectrum is unlike any known LMXB or X-ray transient in that it displays strong, broad, variable and complex emission lines of H, He I and He II. The reddened spectrum and interstellar absorption features indicate a probable distance in the range 1 to 3 kpc. Charged coupled device photometry reveals that the source is variable, but gives no indication of the orbital period, there being no eclipse or regular modulation. ESA

N90-25725# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
SUPER-CRITICAL ACCRETION IN CIR X-1

H. Inoue *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 109-112 (For primary document see N90-25711 19-89)
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In the outburst, the X-ray flux from Cir X-1 often exceeds the peak flux of the one X-ray burst which showed photospheric expansion. The peak flux of such bursts is believed to correspond to the Eddington limit. The apparent super-Eddington flux, the radio flaring, the heavy and partial X-ray absorption, the ultrasoft spectrum and the spectral softening with the flux are qualitatively interpreted. The observations are supposed to be due to the large mass-transfer, exceeding the critical accretion rate, which occurs at the periastron passage of a neutron star in a highly eccentric binary system. ESA

N90-25726# Mullard Space Science Lab., Dorking (England).
ACCRETION DISKS IN LOW-MASS X RAY BINARIES
Keith O. Mason *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 113-120 Sponsored in part by Royal Society of London (For primary document see N90-25711 19-89)
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Observational material relating to low-mass X-ray binaries is reviewed. The data shows evidence of an accretion disk corona. Special attention is given to what can be learned about the structure of the accretion disk that feeds the X-ray source. Parallels are drawn between accretion disk corona sources, those which exhibit X-ray dips, and certain cataclysmic variables. ESA

N90-25727*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
STUDIES OF THE POSSIBLE X RAY TRIPLE 4U1915-05
Jonathan E. Grindlay *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 121-126 (For primary document see N90-25711 19-89)
(Contract NAS8-30751; NAGw-624)
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New optical observations of the X-ray dip and burst source 4U1915-05 were made. They are compared with new X-ray observations from Ginga. The optical modulation is at a period significantly longer than the X-ray dip period, and the stability of the optical period over approximately 2.5 years suggests it is the orbital period. The optical modulation is found to vary in shape on timescales of days but without significant color modulation. Comparison between 1916 and other systems are made. A discussion is given of a hierarchical triple model previously proposed to explain the dips, the optical modulation, and the long-term period. ESA

N90-25728# Leicester Univ. (England). Dept. of Physics and Astronomy.
SUPERHUMPS IN ACCRETION DISKS
R. Whitehurst and A. R. King *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 127-128 Sponsored by United Kingdom Science and Engineering Research Council (For primary document see N90-25711 19-89)
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The investigation shows that the superhumps observed in superoutbursts of SU UMa dwarf novae probably result from the excitation of a resonance in the accretion disk near the 3:1 commensurability with the binary orbit. This resonance can only appear for mass ratios M1/M2 less than 0.25 to 0.33. For larger mass ratios the available resonances are probably too weak to have observable effects. The 2:1 resonance may appear with ultrashort periods. ESA

N90-25729# Royal Greenwich Observatory, Hailsham (England).
GLOBULAR CLUSTER X RAY BINARIES
P. A. Charles *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 129-137 (For primary document see N90-25711 19-89)
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A review on recent observational progress on all the globular cluster X-ray sources, with emphasis on EXOSAT and Ginga results and associated ground based studies is given. It is known that the population of cluster sources divides into high and low L sub x sources. The low L sub x group itself divides into 2 subgroups of which the fainter sources were believed to be Cataclysmic Variables (CVs). No observational support can be found for this. Other programs to search for CVs in globular clusters are described. ESA

N90-25730# Oxford Univ. (England). Nuclear Physics Lab.
THE LOW MASS X RAY BINARIES IN THE LMC
P. J. Callanan and P. A. Charles (Royal Greenwich Observatory, Tenerife, Spain) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 139-143 (For primary document see N90-25711 19-89)
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New optical observations of the LMC Low Mass X-ray Binaries (LMXBs), LMC X-2 and CAL87 are presented. Evidence for an 8.15 hour periodicity in the light curve of LMC X-2 is found. The optical behavior of the 10.6 hour binary CAL87 (discovered as a result of the Columbia Astrophysics Laboratory survey of the Large Magellanic Cloud (LMC)) is discussed in the light of its remarkable similarity with X1822-371. The implications of the observations are reviewed for the class of LMC LMXBs and their relationship with their galactic counterparts. ESA

N90-25731# Observatoire de Haute Provence, Forcalquier (France).
OPTICAL OBSERVATIONS OF LMXB AC211(M15): SOLVING THE PUZZLE
Sergio A. Ilovaisky *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 145-150 (For primary document see N90-25711 19-89)
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Optical spectroscopic results on AC211, the Low Mass X-ray Binary (LMXB) in the M15 globular cluster, are presented. It is found that the He and H absorption lines in this system are produced in a structured gas outflow. Moreover, the systemic velocity of the binary is consistent with that of the cluster. ESA

N90-25732# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
THE POSSIBLE X RAY TRIPLE 4U2129+47 (=V1727 CYGNI)
Michael R. Garcia *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 151-156 (For primary document see N90-25711 19-89)
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The evidence which indicates that the Low-Mass-X-Ray-Binary (LMXRB) 4U2129+47 is a triple system is discussed. This evidence includes the lack of large radial velocity variations, lack of photometric variations, and spectral type observed in the current off state. The detection of a small shift in the systemic radial velocity measured at one epoch relative to the measurements at three other epochs is considered. This shift is interpreted as orbital motion of the observed F7V star around the inner LMXRB. The radial velocity of this system is measured. The evidence that 4U2129+47 is actually a triple system is reviewed. Measurements

of the radial velocity of the system with recent (July 89) data are discussed. ESA

N90-25733*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EMISSION LINES FROM X RAY BINARIES
T. R. Kallman *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 157-161 (For primary document see N90-25711 19-89)
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Emission lines are probes of the conditions in the accretion flows associated with binary X-ray sources. The hard X-ray iron K line, soft X-ray lines, and UV lines, and what they indicate about the conditions in binary X-ray sources are discussed. These lines are interpreted using an X-ray illuminated accretion disk model. The structure and dynamics of the heated disk, its spectral signatures, and the major unsolved theoretical issues surrounding them are investigated. ESA

N90-25734# Leicester Univ. (England). Dept. of Physics.
X RAY OBSERVATIONS OF SS433 AND ITS JETS
G. C. Stewart, H.-C. Pan, and N. Kawaii (Institute of Physical and Chemical Research, Saitama, Japan) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 163-170 (For primary document see N90-25711 19-89)
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The EXOSAT and Ginga observations of SS433 are discussed. They are used to show that the major factors in determining the variations in the X-ray emission from the jets of SS433 are precessional and orbital geometric influences. Limits on the sizes and masses of the system components and the structure of the X-ray emitting material within the jets are derived. Evidence that the line profile is significantly variable with precession phase suggest that some Compton broadening of the line is required. ESA

N90-25735# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
UPPER LIMITS ON Co-57 ABUNDANCE IN SN1987A ACCORDING TO THE KVANT DATA
Rashid A. Sunyaev, V. V. Efremov, A. S. Kaniovsky, S. A. Grebenev, C. Reppin, W. Pietsch, J. Englhauser, J. Truemper, W. Voges, and E. Kendziorra (Tuebingen Univ., Germany, F.R.) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 171-172 (For primary document see N90-25711 19-89)
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Seven hard X-ray spectra of SN1987A obtained at different times by instruments onboard Kvant module are presented. During June observations the flux from the supernova was not detected. Only three sigma limits are presented. The 50-millisecond pulsar PSR 0540-693 and LMC X-1 were also in the field of view of HEXE instrument during the June observations. ESA

N90-25736# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
CYCLOTRON ABSORPTION IN GAMMA RAY BURSTS SEEN WITH GINGA
T. Murakami *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 173-177 (For primary document see N90-25711 19-89)
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Spectral features are found in the gamma ray burst spectra from two bursts at about 20 keV, 40 keV and possibly at about 60 keV from one burst. A shift of energy of the cyclotron absorption is also observed. The interpretation of these features as the fundamental and second harmonics of the cyclotron absorption lines requires a strong magnetic field of 10 to the 12 power gauss at the absorption region of the gamma ray bursts. This supports the hypothesis that the gamma ray bursts originate near the surface of strongly magnetized neutron stars. The origin of such strong magnetic fields is discussed in the framework of current theories of evolution of neutron stars and their field decay. ESA

N90-25737# Raman Research Inst., Bangalore (India).
THE DECAY OF NEUTRON STAR MAGNETIC FIELDS
D. Bhattacharya *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 179-184 (For primary document see N90-25711 19-89)
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The evolution of neutron stars is determined by the evolution of their magnetic fields. The observational evidence for field evolution is presented. Recent observations suggest that the magnetic field of a neutron star initially decays with a timescale of a few million years, but becomes virtually constant at late times. Theoretical models for such a field evolution are discussed. ESA

N90-25738# Amsterdam Univ. (Netherlands). Inst. of Astronomy.
NON-THERMAL RADIO EMISSION OF X RAY BINARIES
W. Penninx *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 185-196 (For primary document see N90-25711 19-89)
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A review of the different groups of radio emitting X-ray sources is given. The sources are described along the lines of their X-ray characteristics. Emphasis is placed on the developments in the X-ray/radio correlations in the Z-sources. Some characteristics of the Z-sources are used to determine their distances. The atoll sources, the other group of the persistent bright low mass X-ray binaries, appear to be weaker at radio wavelengths than the Z-sources. ESA

N90-25739# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
GINGA OBSERVATIONS OF QPO
Kazuhisa Mitsuda *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 197-202 (For primary document see N90-25711 19-89)
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The Ginga results for the horizontal branch Quasi-Periodic Oscillation (QPO) (23 to 40 Hz) from GX 5-1 and 6 Hz QPO from 6 low-mass binary X-ray sources are presented. The power spectra of GX 5-1 in the horizontal branch were analyzed with model functions based on the oscillating shot models. To fit the observed power spectra with these models two different life times in the shots are assumed. The powers of the low frequency noise and the QPO were found to show temporal variations on time scales of 256 seconds. These variations are correlated with each other on time scales longer than a fews tens of seconds. The energy dependency of the 6 Hz QPO amplitude is presented. For the normal branch QPO from Z-sources and the broad peak features in the power spectra of two atoll sources, the difference between the spectra at the top and at the bottom of the oscillations is found to have the appearance of a roughly 2.2 keV blackbody spectrum. ESA

N90-25740# Amsterdam Univ. (Netherlands). Inst. of Astronomy.
THE Z/ATOLL CLASSIFICATION
M. vanderKlis (Center for High-Energy Astrophysics, Amsterdam, Netherlands) *In* ESA, The 23rd ESLAB Symposium on Two

Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 203-207 (For primary document see N90-25711 19-89)
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The status of the classification of bright low mass X-ray binaries into Z and atoll sources is reviewed. Preliminary results indicate that certain X-ray burst properties correlate strongly with source state in the atoll sources 4U1636-53 and 4U1705-44. Model scenarios for this complex phenomenology are outlined. Examples of color-color diagrams are given. ESA

N90-25741# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
QPO FROM THE RAPID BURSTER
T. Dotani *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 209-213 (For primary document see N90-25711 19-89)
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Strong Quasi-Periodic Oscillations (QPO) in type 2 bursts from the rapid burster with Ginga were detected. The QPD have centroid frequency of approximately 5 and 2 Hz during bursts which lasted for approximately 10 and 30 sec, respectively. The QPO observations were analyzed and the following results were obtained: QPO centroid frequencies have some correlation with burst duration and peak count rate, however the correlations are complicated and the burst parameters do not uniquely determine the QPO centroid frequency; the appearance of the QPO is closely related to the so-called timescale-invariant profile of the bursts; the QPO are significant only in the even numbered peaks of the profile and not in the odd numbered peaks; in most cases the QPO centroid frequency decreases up to approximately 25 percent during a burst. The energy spectra at the QPO peaks and valleys were investigated and the QPO peaks were found to have significantely higher blackbody temperature than the QPD valleys. ESA

N90-25742*# Illinois Univ., Urbana-Champaign. Dept. of Physics and Astronomy.
A UNIFIED MODEL OF ACCRETION FLOWS AND X RAY EMISSION IN LOW MASS X RAY BINARY SYSTEMS
F. K. Lamb *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 215-229 (For primary document see N90-25711 19-89)
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Recent work on a unified model of accretion flows and X-ray emission in low mass X-ray binaries is summarized. In this model, a weakly magnetic neutron star accretes gas simultaneously from a Keplerian disk and a corona above the inner part of the disk. Photons are produced and escape through an approximately radial inflow of gas captured from the inner disk corona. Changes in the optical depths of the central corona and the radial flow may explain the Z-shaped hardness-intensity and color-color tracks observed in the most luminous sources. Numerical simulations show that the radial flow oscillates when the luminosity rises to within a few percent of the Eddington critical luminosity L sub E, and that the oscillation frequency is approximately 5 to 10 Hz if the radial flow develops approximately 300 km from the neutron star. The 10 to 20 Hz oscillations observed in Sco X-1 when it is on the flaring branch are discussed. ESA

N90-25743# Osaka Univ., Toyonaka (Japan). Dept. of Physics.
QPOS FROM BLACK-HOLE CANDIDATES
Shunji Kitamoto *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 231-236 (For primary document see N90-25711 19-89)
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Ginga observed the following black-hole candidates: Cyg X-1, LMC X-1, LMC X-3, GX339-4, GS2000+25 and GS2023+39. Observed properties about Quasi-Periodic Oscillation (QPO) and time variation of these black hole candidates are presented. The observed properties of the time variations of GX 339-4 and LMC X-1 suggest that the energy spectrum is composed of a soft and a hard component. The hard component of GX339-4 has two states. Rapid alternations of these states suggest that the size of the hard component emitting region is less than 2.8 times 10 to the 9th power cm. Significant time lags of high energy and also low energy X-rays in reference to the X-rays in the energy range between 2.3 keV were found. Cyg X-1 and GS2023+339 do not show QPO but they show violent time variation. These sources also show hard X-ray lags. ESA

N90-25744# Rikkyo Univ., Tokyo (Japan). Dept. of Physics.
THE IMPACTS OF GINGA RESULTS ON QPO MODELS
Noriaki Shibazaki *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 237-240 Sponsored in part by the Ministry of Education, Science and Culture, Sagamihara, Japan (For primary document see N90-25711 19-89)
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Quasi-Periodic Oscillation (QPO) observations and the physical causes of QPO are studied. In the light of the recent results from Ginga observations, the physical properties required of QPO models are discussed and the existing QPO models are examined, especially the beat frequency model. The accretion torque theory in the context of the X-ray pulsar QPO is considered. ESA

N90-25745# Columbia Univ., New York, NY. Dept. of Physics.
RADIATION-DRIVEN EVOLUTION AND STATISTICS OF LOW-MASS X RAY BINARIES
Marco Tavani (Rome Univ., Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 241-246 (For primary document see N90-25711 19-89)
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Implications for the newly discovered eclipsing millisecond pulsar PSR 1957+20, Cyg X-3, and the statistics of LMXB's versus galactic millisecond pulsars are discussed. The evolution of Low-Mass X-ray Binaries (LMXB's) may be influenced by radiation produced by the primary star during the accretion and post-accretion phases. If the companion star is illuminated during the accretion phase by a relatively large flux of X-rays and/or 1 MeV gamma rays, an evaporative mass can self-sustain accretion at a rate close to the primary's Eddington limit until a sudden accretion turn-off occurs. ESA

N90-25746# Leicester Univ. (England). X Ray Astronomy Group.
MOVING OUT OF THE GALAXY: FUTURE PROSPECTS FOR X RAY BINARIES STUDIES
M. G. Watson *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 247-251 (For primary document see N90-25711 19-89)
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An overview of new X-ray satellite projects expected to be launched in the next decade is presented. Emphasis is given to missions based on imaging X-ray telescopes. The capabilities of these missions are summarized, and their performance is compared with what is possible with previous and current instrumentation. Two example studies are discussed: imaging the galactic ridge to probe faint X-ray binary populations in our galaxy, and studies of X-ray binary populations in external galaxies. ESA

N90-25747# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
X RAY OBSERVATIONS OF GS2023+338 BY THE KVANT MODULE
V. Arefev, K. Borozdin, E. Churazov, V. V. Afremov, M. R. Gilfanov, A. Kaniovskiy, A. V. Kuznetsov, A. Melioranskiy, Rashid A. Sunyaev, and N. Yamburenko et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 255-261 (For primary document see N90-25711 19-89)
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Following the discovery of GS2023+338 by Ginga, the source was detected in the 2 to 300 keV energy band by the experiments onboard the Kvant module. The source position was localized using data from the coded mask imaging spectrometer. Between Jun. 8 to Aug. 1989 a continuous decrease of X-ray luminosity and strong short time variability were detected. Timing analysis showed strong low frequency noise in the power spectrum of the source. ESA

N90-25748# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
THE SOFT GAMMA RAY BURSTS DETECTED WITH THE APEX EXPERIMENT: EVIDENCE FOR A PERSISTENT SGR-LIKE ACTIVITY
J.-L. Atteia, C. Barat, A. Chernenko, V. Dolidze, A. Dyatchkov, E. Jourdain, S. Khariukova, N. Khavenson, A. Kozlenkov, and R. Kucherova (Academy of Sciences, USSR, Moscow) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 263-265 (For primary document see N90-25711 19-89)
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Among gamma ray bursters, the Soft Gamma Repeaters (SRGs) constitute a particular class characterized by short periods of intense activity and long quiet periods lasting at least 1 year. The behavior of SGR 1806-21, watched during about 7 years, was studied in detail. The detection, by the Soviet-French Apex experiment, of 6 soft bursts with characteristics identical to SRG repetitions is reported. It is shown that these observations argue in favor of a persistent SRG type activity. The implications of these detections for SRG observations with future missions are considered. ESA

N90-25749# Observatoire du Pic-du-Midi, Bagneres de Bigorre (France).
M15:AC211/X2127+119: OPTICAL CURVE, IMPROVED EPHEMERIS, AND PHASING OF EXOSAT X RAY DATA
Michel Auriere, Sergio A. Ilovaisky, Lydie Koch-Miramond, Claude Chevalier, and Jean-Pierre Cordoni (Universite des Sciences et Techniques du Languedoc, Montpellier, France) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 267-268 (For primary document see N90-25711 19-89)
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The study of the high resolution charged-coupled device images of the M15 globular cluster is carried out. Analysis of the U-band images yielded 358 differential photometric measurements and timing analysis of this data set allowed improvement of the orbital period for the system. The two sets in which data can be separated, when folded with the new ephemeris, are shown. The EXOSAT data is discussed in the framework of the new ephemeris. ESA

N90-25750# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
EXOSAT OBSERVATIONS OF CYGNUS X-1: STUDY OF THE SOFT X RAY EXCESS
Monika Balucinska (Polish Academy of Sciences, Warsaw.) and Guenther Hasinger *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 269-274 (For primary document see N90-25711 19-89)
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Ten observations of Cygnus X-1 made by the EXOSAT medium energy experiments in the period of 1984 to 1985 when the source was in its low state are examined. The presence of a soft component (black body temperature of around 0.2 keV) on top of the high energy power law component is confirmed in all spectra. The emission line at 6.2 keV is also visible and its intensity varies during the dips. The soft component undergoes more distinct fluctuations than the hard one, which is well seen on a color-color and a color-intensity diagram. The results are discussed in the framework of an accretion disc model. ESA

N90-25751# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). EXOSAT Observatory.
THE SOFT X RAY SPECTRUM OF CYGNUS X-1
P. Barr and H. vanderWoerd *In its* The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 275-27 (For primary document see N90-25711 19-89)
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Simultaneous observations of the 0.4 to 2 keV and 2 to 12 keV spectrum of Cyg X-1 are presented. They were performed with the low energy transmission grating spectrometer and gas scintillation proportional counter on board the EXOSAT observatory. At least four spectral components are required to describe the data: a hard power law dominating the emission above 2 keV; a broad emission line near 6.3 keV; a steep continuum below 2 keV; and broad emission feature between 600 and 800 eV. Conventional viscous accretion disk models cannot simultaneously explain both the spectral shape and the luminosity of the steep soft continuum component. ESA

N90-25752# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. Astrofisica Spaziale.
HARD X RAY OBSERVATIONS OF GALACTIC SOURCES
A. Bazzano, I. R. Carstairs, M. J. Coe, A. Court, S. R. Davies, A. J. Dean, N. Dipper, R. Lewis, P. Maggioli, and A. J. Norton (Southampton Univ., England) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 279-281 (For primary document see N90-25711 19-89)
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A number of galactic sources observed by the hard X-ray telescope Mifrasco during the course of two balloon flights from the Milo base in Trapani (Sicily) in July 1986 and 1987 are presented. Emission spectra was measured over the energy range 15 to 300 keV from the Crab nebula and the transient source A0535+26, and timing analyses were performed. Upper limits to the emission from the X-ray pusisar Her X-1 and the peculiar emission line object SS 433 were obtained. ESA

N90-25753# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
NOISE VARIABILITY IN CYG X-1 AND HER X-1
Tomaso Belloni and Guenther Hasinger *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 283-287 (For primary document see N90-25711 19-89)
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The aperiodic variability in the X-ray emission of Cyg X-1 and Her X-1 is examined from EXOSAT archive data by means of the production of broad band power spectra. The power spectra of Cyg X-1 show a high rms, a complex shape and variations of the break frequency over one order of magnitude. Good agreement is obtained with a shot noise model with a distribution in shot lifetimes. The noise in Her X-1 shows variations correlated with the 35rd

cycle of the source. The observations are consistent with occultation by the inner accretion disk. ESA

N90-25754# Catania Univ. (Italy). Ist. di Astronomia.
THREE DIMENSIONAL ACCRETION DISK SIMULATION WITH EXTERNAL MAGNETIC FIELD
G. Belvedere, G. Lanzafame, and D. Molteni (Palermo Univ., Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 289-291 (For primary document see N90-25711 19-89)
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The main physical phenomena which occur on accretion disks, are discussed. A numerical simulation of a three dimensional accretion disk model around a white dwarf in a binary system composed of two equal mass stars is developed. The smoothed particle hydrodynamics interpolation method is adopted to solve the magnetohydrodynamic equations in the Lagrangian formalism. ESA

N90-25755# Nuffield Radio Astronomy Labs., Jodrell Bank (England).
A SEARCH FOR RADIO PULSARS IN GLOBULAR CLUSTERS AND TRANSIENT X RAY SOURCES
J. D. Biggs, A. G. Lyne, and S. Johnston *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 293-299 (For primary document see N90-25711 19-89)
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The results of an ongoing search for pulsars in globular clusters and transient X-ray sources are presented. Since the discovery of the millisecond pulsar PSR 1821-24 in M28 one new pulsar was discovered, PSR 1620-26, in a binary system in the core of the globular cluster M4. Upper limits to pulsed emission are given for the 84 globular clusters and 3 X-ray transient sources observed. The paucity of new discoveries in globular clusters by this survey is considered. The inability to detect X-ray sources may be the result of processes related to their accretion disks. An improvement in sensitivity afforded by a planned software enhancement may reveal some pulsars in the objects observed. ESA

N90-25756# Bologna Univ. (Italy). Dipt. di Astronomia.
THE BEHAVIOUR OF SS433 AND CYGNUS X-3 AT LOW FREQUENCY
S. R. Bonsignori-Facondi and S. Montebugnoli (Consiglio Nazionale delle Ricerche, Bologna, Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 301-304 (For primary document see N90-25711 19-89)
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Flux density variations of SS433 and Cygnus X-3 at 73.5 cm are reported. The periods respectively Apr. 1980 to Dec. 1988 and Nov. 1983 to Sep. 1985 are considered. During these periods the flux density of SS433 varied from 1.45 Jy up to 4.2 Jy and that of Cygnus X-3 from 0.7 Jy up to 2.2 Jy. Flaring events (outbursts) on time scale of one day were detected in both objects. ESA

N90-25757# Sternberg Astronomical Inst., Moscow (USSR).
X RAY NOVA GS 2000+25 = NOVA VUL 1988: X RAY AND OPTICAL LIGHT CURVES, SPECTRA, AND MODEL
N. V. Borisov, N. G. Bochkarev, S. A. Gladyshev, S. A. Grebenev, A. I. Dolgushin, S. A. Zhekov, E. A. Karitskaya, N. E. Kurochkin, S. I. Neizvestny, and E. P. Pavlenko (Crimean Astrophysical Observatory, USSR) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 305-309 (For primary document see N90-25711 19-89)
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The results of optical and X-ray observations of X-ray Nova Vul 1988 are presented. The observations, performed on the module Kvant, revealed a soft and a hard component of the X-ray spectrum. The discussion is carried out in the framework of the model of nonstationary disc accretion. The assumption on the disk accretion taking place onto a black hole of stellar mass is made. ESA

N90-25758# Durham Univ. (England). Dept. of Physics.
VHE GAMMA RAY EMISSION FROM SOUTHERN HEMISPHERE X RAY BINARIES
K. T. S. Brazier, A. Carraminana, P. M. Chadwick, N. A. Dipper, E. W. Lincoln, V. G. Mannings, T. J. L. McComb, K. J. Orford, S. M. Rayner, and K. E. Turver *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 311-314 (For primary document see N90-25711 19-89)
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A search for emission of 300 GeV gamma rays from Sco X-1, Cen X-3 and Vela X-1 was made using the Narrabri (New South Wales, Australia) gamma ray telescope. DC gamma ray emission from Sco X-1 was detected in data taken during 1988 and confirmed with data taken during 1989. There is some evidence that the data is modulated with the 0.787 d orbital period. Observations made of Cen X-3 show evidence for pulsed Very High Energy (VHE) gamma ray emission. The VHE emission is strongest for a few hours around the ascending node in the 2.1 d binary orbit. The time averaged energy flux in VHE gamma rays is estimated. Measurements of Vela X-1 confirm earlier claims and indicate emission of VHE gamma rays. ESA

N90-25759# Durham Univ. (England). Dept. of Physics.
EVIDENCE OF A 12 ms PULSAR IN CYGNUS X-3
K. T. S. Brazier, A. Carraminana, P. M. Chadwick, N. A. Dipper, E. W. Lincoln, T. J. L. McComb, K. J. Orford, S. M. Rayner, and K. E. Turver *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 315-319 Sponsored by United Kingdom Science and Engineering Research Council (For primary document see N90-25711 19-89)
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Cygnus X-3 was observed in 1988 using the Durham University Mark 4 gamma ray telescope. Data shows further evidence for pulsed emission at a phase in the 4.8 hr cycle and with a pulsar period and secular period derivative. The conservative overall Rayleigh probability of uniformity of phase for this new result is 1.7 times 10 to the minus 6th power. A re-analysis of the data from observations of Cygnus X-3 from 1981 to 1985 using a new X-ray ephemeris of the 4.8 hr X-ray cycle suggests that from 1981 to 88 Cygnus X-3 is producing sporadic very high frequency gamma rays at a fixed time in the 4.8 hr X-ray cycle. ESA

N90-25760# Durham Univ. (England). Dept. of Physics.
VHE GAMMA RAY EMISSION FROM NORTHERN HEMISPHERE X RAY BINARIES
K. T. S. Brazier, A. Carraminana, P. M. Chadwick, N. A. Dipper, E. W. Lincoln, T. J. L. McComb, K. J. Orford, S. M. Rayner, and K. E. Turver *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 321-324 Sponsored by United Kingdom Science and Engineering Research Council (For primary document see N90-25711 19-89)
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A search for emission of pulsed 400 GeV gamma rays from Her X-1, 4U0115+63 and 1E2259+586 was made using data recorded with the La Palma (Canary Islands) gamma ray telescope during 1988. One episode of pulsed emission was observed from Her X-1. Suggestions for the emission of pulsed Very High Energy (VHE) gamma rays by 4U115+63 in the observations made in 1984 using the Dugway telescopes are confirmed in late 1988

observations. Evidence for VHE gamma ray emission from 1E2259+586 is found in data from measurements in Oct. 1988. ESA

N90-25761# Durham Univ. (England). Dept. of Physics.
THE DETECTION OF VHE GAMMA RAYS USING THE ATMOSPHERIC CERENKOV TECHNIQUE
K. T. S. Brazier, A. Carraminana, P. M. Chadwick, N. A. Dipper, E. W. Lincoln, T. J. L. McComb, K. J. Orford, S. M. Rayner, and K. E. Turver *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 325-329 (For primary document see N90-25711 19-89)
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The atmospheric Cerenkov technique for the detection of Very High Energy (VHE) gamma rays is outlined. The construction, performance and sensitivity of the ground based gamma ray telescopes operating at Narrabri, New South Wales, Australia and La Palma, Canary Islands are described. A method for optimizing the distribution of mirror area is developed. The choice of the acceptance angle and the focal length are discussed. ESA

N90-25762# Oxford Univ. (England). Nuclear Physics Lab.
OPTICAL OBSERVATIONS OF GS2000+25
P. J. Callanan and P. A. Charles (Royal Greenwich Observatory, Tenerife, Spain) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 331-333 (For primary document see N90-25711 19-89)
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The preliminary results of a campaign to study the optical counterpart of the X-ray nova GS2000+25 in quiescence, using the Isaac Newton Telescope on La Palma (Canary Islands) are presented. Evidence for short term variability in quiescence on a time scale of hours or less is found. No evidence for the approximately 7 hour period is detected. The variability observed may be consistent with ellipsoidal variations of the secondary. ESA

N90-25763# Abastumani Astrophysical Observatory, Georgia (USSR). Town Lab.
TURBULIZATION OF SHEAR FLOWS IN ASTROPHYSICS c90
G. D. Chagelishvili, R. G. Chanishvili, L. G. Filipov, T. Christov (Bulgarian Academy of Sciences, Sofia.), and J. G. Lominadze *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 335-340 (For primary document see N90-25711 19-89)
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A general approach is used to explain the turbulization of incompressible free shear fluid flows. The determination of a universal criterion for the dynamic instability in a rotating fluid and the nature and nonlinear effects during the evolution of vertical perturbations in free shear flows are discussed. An attempt at understanding the physical causes of turbulization of such flows is made. The theory of turbulization can be applied to accretion disks, galactic disks, planetary rings and protostellar nebulae. ESA

N90-25764# Observatoire de Haute Provence, Forcalquier (France).
UNUSUAL COUNTERPARTS OF THE SOFT X RAY TRANSIENTS 4U 1543-47 AND 4U 2129+47 IN QUIESCENCE: INTERLOPERS OR THIRD STARS
Claude Chevalier *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 341-344 (For primary document see N90-25711 19-89)
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Optical observations of soft X-ray transients in quiescence are considered in the study of low mass X-ray binaries. Recent observations of two systems, 4U 2129+47 and 4U 1543-47, are discussed. In both cases the optical objects do not correspond to the expectations. The question of whether the objects are interlopers in the line of sight or physically associated with the X-ray source is analyzed. ESA

N90-25765# Observatoire de Haute Provence, Forcalquier (France).
XB 1905+00: A VERY COMPACT LOW-MASS X RAY BINARY VIEWED AT LOW INCLINATION
Claude Chevalier and Sergio A. Ilovaisky *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 345-347 (For primary document see N90-25711 19-89)
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Both the X-ray behavior and the intrinsic faintness of the optical counterpart of the burst source XB 1905+000 are suggestive of a very compact system viewed at low inclination. From the analysis of EXOSAT observations of the burst, in September 1985, a composite spectrum was revealed. Moreover, it was shown how the black body burst emission evolved into a small black body component seen in the persistent flux. Assuming an Eddington-limited peak, bolometric luminosity at a distance of about 8 kpc to the source was derived. Plausible constraints on the mass and radius of the neutron star were obtained. ESA

N90-25766# Consiglio Nazionale delle Ricerche, Milan (Italy). Ist. di Fisica Cosmica.
IS KO VEL (E1013-477) AN INTERMEDIATE POLAR
L. Chiapetti, L. Maraschi, R. M. Sambruna, and A. Treves (Milan Univ., Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 349-352 (For primary document see N90-25711 19-89)
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The X-ray observations (0.1 to 9 keV) of the cataclysmic variable KO Vel (E1013-477) made with EXOSAT in 1984 are reported. The data shows no obvious evidence for any of the periods proposed for this source from optical observations. An estimate of the spectrum as a flat power law with low interstellar absorption is obtained. The results are discussed in the framework of the classification of the object as a magnetic cataclysmic variable. ESA

N90-25767# California Univ., San Diego. Center for Astrophysics and Space Sciences.
CORRELATIONS BETWEEN X RAY LUMINOSITY AND PULSE SHAPE AS WELL AS SPECTRAL SHAPE IN BINARY X RAY PULSARS
W. Collmar (Tuebingen Univ., Germany, F.R.) and D. E. Gruber *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 353-357 (For primary document see N90-25711 19-89)
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The correlations between X-ray luminosity and pulse shape and spectral shape in selected X-ray pulsars are presented to check proposed trends which were noted with changing luminosity between differents pulsars. Individual pulsars at different luminosity states are analyzed using archival data. In a sample of five different sources pulse profile changes are found in all sources. Only the low luminosity sources GX 301-2 and 4U 1538-52 show the expected change of complexity. The three other sources show indefinite results. Out of a sample of three different sources for which spectral analysis was performed, both low luminosity sources, GX 301-2 and Vela X-1 show the expected behavior: a steeper spectral cutoff in their higher luminosity state. ESA

N90-25768# Consiglio Nazionale delle Ricerche, Palermo (Italy).
VARIABILITY OF THE X RAY SOURCES IN M31
A. Collura, F. Reale, and G. Peres (Osservatorio Astrofisico,

Palermo, Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 359-364 Sponsored by CNR-NATO; Sicilian Consiglio Regionale delle Ricerche Nucleari e della Struttura della Materia; and Italian Ministry of Public Education (For primary document see N90-25711 19-89)

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The Einstein observations of M31, looking for variability of the X-ray sources up to time scales of approximately 100,000 are analyzed. Two sources are significantly variable. The characteristics of their variability are discussed and constraints on their possible periodicity are derived. The observed X-ray luminosities, the pattern of variability, and the optical identifications suggest the possibility that one of them is low mass X-ray binary and the other one a compact massive X-ray binary. ESA

N90-25769# International School for Advanced Studies, Trieste (Italy).

EXPLODING NEUTRON STARS NEAR THE MINIMUM MASS: THE TOTAL ENERGY RELEASE

Monica Colpi, Stuart L. Shapiro, and Saul A. Teukolsky (Cornell Univ., Ithaca, NY.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 365-368 (For primary document see N90-25711 19-89)

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The explosion of a neutron star whose mass falls below the minimum stable mass on the equilibrium curve is discussed. After the explosion the neutron star provides a natural setting for an intense burst of antineutrinos. The high temperatures attained from expanding suggest that the process leads to a significant emission of high energy thermal radiation. The instability to expansion triggered by neutron beta decays drives the star to disrupt catastrophically on a time scale of between a few milliseconds to a few seconds. ESA

N90-25770# Palermo Univ. (Italy). Ist. di Fisica.

X RAY TIMING AND SPECTRAL MEASUREMENTS OF THE X RAY PULSAR 4U 1538-52

G. Cusumano, N. R. Robba, M. Orlandini, Daniele DalFiume, and Filippo Frontera (Ferrara Univ., Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 369-374 (For primary document see N90-25711 19-89)

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The medium energy experiment onboard the EXOSAT satellite observed the X-ray binary system 4U 1538-52 on four occasions during March and August 1984. Observed pulsation periods indicate that the neutron star in the 4U 1538-52 system continued to spin down with P rate/P = 0.00023/yr in the period 1976 to 1988. The eclipse transition time of approximately 0.06 days gives a height of 1.5 times 10 to the 11th power cm for the atmosphere of the optical counterpart. The phase-average X-ray spectrum shows an iron line. The spectral form shows variations with pulse-phase. ESA

N90-25771# Warsaw Univ. Observatory (Poland).

CORONAE AND WINDS AROUND ACCRETION DISCS
Abstract Only

M. Czerny and A. R. King (Leicester Univ., England) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 375 (For primary document see N90-25711 19-89)

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The presence of alpha-viscosity in the atmospheres of accretion discs is investigated. It results in the existence of coronae and/or winds. When discs are illuminated by the central X-ray sources, the mass loss may be a significant fraction of the total mass transfer rate. The optical depth of the wind depends strongly on the viscosity parameter. The constancy of the relative X-ray eclipse depths in some X-ray sources is discussed. ESA

N90-25772# Tata Inst. of Fundamental Research, Bombay (India).

DETECTION OF 2.93 ms PULSATIONS IN SCO X-1

S. V. Damle, P. K. Kunte, D. A. Leahy, S. Naranan, B. V. Sreekantan, and D. Venkatesen (Calgary Univ., Alberta) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 377-379 Sponsored by Canadian Natural Sciences and Engineering Research Council (For primary document see N90-25711 19-89)

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The high frequency coherent pulsations detected during an observation of Sco X-1 are reported. Scorpius X-1 is an X-ray binary in the class exhibiting Quasi-Periodic Oscillations (QPO). The observation was taken with a balloon-borne phoswich detector sensitive to X-rays in the 18 to 120 keV energy band. Models for QPO sources involve a neutron star with low magnetic field and high spin rate in orbit with a low mass stellar companion. The pulsations are interpreted as the spin period of the neutron star. ESA

N90-25773# Southampton Univ. (England). Dept. of Physics.

HEAO-1 AND IR OBSERVATIONS OF THE X RAY PULSAR 1E2259+586

S. R. Davies, M. J. Coe, and K. S. Wood (Naval Research Lab., Washington, DC.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 381-386 Sponsored by United Kingdom Science and Engineering Research Council (For primary document see N90-25711 19-89)

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The analysis of HEAO-1 scanning observations of the X-ray pulsar 1E2259+586 from 1978 is reported. The period at this epoch was 6.978586 more or less 0.000006s, consistent with an extrapolation of the spindown trend. The luminosity and pulse profile are similar to those of subsequent observations. Deep IR images of the region of 1E2259+586 are presented. No new counterparts are discovered. The possibility that 1E2259+586 is a massive, heavily reddened system can be discounted. The implications of these results are discussed in terms of evolutionary models and an explanation for the observed spindown is proposed. ESA

N90-25774# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.

OBSERVATIONS OF BLACK HOLE CANDIDATES WITH THE MIR-KVANT HEXE

S. Doebereiner, J. Englhauser, W. Pietsch, C. Reppin, J. Truemper, E. Kendziorra, M. Maisack, B. Mony, R. Staubert, and V. V. Efremov (Academy of Sciences, USSR, Moscow) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 387-392 (For primary document see N90-25711 19-89)

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The three black hole candidates Cygnus X-1, GX339-4, and the X-ray transient source GS2000+25 were observed with the High Energy X-ray Experiment (HEXE) aboard the Soviet Space Station Mir. The spectra and light curves obtained with improved data processing techniques are presented. The spectra of Cygnus X-1 and GS2000+25 in the energy range from 30 to 180 keV deviate from simple power laws and are compatible with either thermal bremsstrahlung from a hot and optically thin plasma or low energy photons comptonized to high X-ray energies in a hot plasma cloud. ESA

N90-25775# Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Astrophysik.

ON THE VISCOSITY IN ACCRETION DISKS

Wolfgang J. Duschl *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 393-396 (For primary document see N90-25711 19-89)
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The physical processes that cause the viscosity in accretion disks are considered. A newly proposed approach that couples viscosity and convection are discussed. It is assumed that only one turbulent process underlies both processes and that it manifests itself in two different geometrical directions in physically quite distinct processes. The models calculated using this ansatz are capable of describing the unstable disk structure without introducing an ad-hoc viscosity parameter, in convective regions, and explaining the UV delay that is observed in some dwarf novae. ESA

N90-25776# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
MIR-KVANT-HEXE HARD X RAY LIGHT CURVE OF SN 1987A
J. Englhauser, S. Doebereiner, W. Pietsch, C. Reppin, J. Truemper, E. Kendziorra, M. Maisack, B. Mony, R. Staubert, and V. V. Efremov (Academy of Sciences, USSR, Moscow) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 397-400 (For primary document see N90-25711 19-89)
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The observations of the supernova 1987A by the High Energy X-ray Experiment (HEXE) on board the Mir-Kvant module are discussed. A total observation time of 530000s was spent on that target, and data are available from day 144 to 843 after the outburst. Four detectors and an improved background subtraction method were used and a final energy calibration was established. A hard X-ray flux from SN 1987A already on day 144 was discovered. X-ray light curves are presented in three energy bands, extending the time coverage to June 1989. The new results confirm the results published earlier. ESA

N90-25777# Technion - Israel Inst. of Tech., Haifa. Dept. of Physics.
X RAYS FROM THE ACCRETION COLUMN OF COMPACT OBJECTS: A MONTE CARLO STUDY
J. Felsteiner and R. Opher (Sao Paulo Univ., Brazil) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 401-404 (For primary document see N90-25711 19-89)
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A model of the X-ray radiation emitted from the accretion column of a compact object in AM Herculis binaries, using Monte Carlo methods is presented. The accretion column in the model has cylindrical symmetry. Above a shocked region in the column there is a preheated region and above it a cool region. Surrounding the three accretion column regions is a cool halo region. Comparing the results with AM Her spectrum from other investigations it is found that: if a halo exists, it is very thin (or has a very low density); the logarithm of the number density is approximately equal to 16.3 and a transverse Thomson optical depth approximately equal to 0.6; the width of the iron line peak obtained is approximately equal to 0.8 keV and insensitive to the transverse Thomson optical depth. ESA

N90-25778# Leicester Univ. (England). Dept. of Physics and Astronomy.
LINEARLY EXTENDED CYCLOTRON EMISSION REGIONS IN AM HERCULIS SYSTEMS
Lilia Ferrario and D. T. Wickramasinghe (Australian National Univ., Canberra.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 405-408 (For primary document see N90-25711 19-89)
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The properties of cyclotron radiation originating from homogeneous arc-shaped emission regions are discussed. The effects of field spread across the shock are taken into account. It is found that arc-shaped cyclotron emission regions give rise to asymmetric light and polarization curves which are in closer agreement with observations of some AM Herculis systems than previous point-source and cylindrically extended models. ESA

N90-25779# Bulgarian Academy of Sciences, Sofia. Space Research Inst.
NONLINEAR PHENOMENA IN ACCRETION DISKS: POSSIBILITY FOR OBSERVATIONAL VERIFICATION
L. G. Filipov *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 409-413 (For primary document see N90-25711 19-89)
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The behavior of the accretion disk is investigated. Equations in variables of the momentum friction force between two adjacent cylinders and the specific angular momentum are used. A few exact solutions are found. A scenario for the evolution of the accretion disk is suggested. The possibilities for the construction of a theory describing the global properties of the accretion disk with viscosity as a main parameter are discussed. ESA

N90-25780# Applied Research Corp., Landover, MD.
SCO X-1 THE MICROQUASAR: NEW VLA AND VLBI RESULTS
B. J. Geldzahler, E. B. Fomalont, and N. L. Cohen (Boston Univ., MA.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 415-417 (For primary document see N90-25711 19-89)
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The results of recent Very Large Array (VLA) and Very Long Base Interferometry (VLBI) Observations of Sco X-1 are reported. The VLA observations confirmed earlier reports of flux density variations of the extended lobes of Sco X-1 and allowed narrowing of the time scale for variation. The new VLBI observations are the first of Sco X-1 with the European VLBI network, and, when combined with earlier VLA and VLBI astrometric observations, allow determination of the relative component motion to better than 10:1. ESA

N90-25781# Helsinki Univ. (Finland). Astrophysics Lab.
UBVRI-PHOTOPOLARIMETRY AND THE X RAY DIPS OF V471 TAU
P. J. Hakala, V. Piirola, O. Vilhu, J. Huovelin, and L. Jetsu *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 419-421 (For primary document see N90-25711 19-89)
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An unpublished set of five color photopolarimetry images of V471 Tau are presented. The possible connections between the X-ray dips observed with EXOSAT and photopolarimetry are discussed. The photometric results seem to confirm the atmospheric model proposed by Guinan. The phase dependent polarization variations are analyzed. A discrete scattering region, responsible for the polarization produced in the double star envelope is considered. ESA

N90-25782# Nagoya Univ. (Japan). Dept. of Astrophysics.
A THEORY OF THE RAPID BURSTER (MXB1730-335)
Tomoyuki Hanawa, Kouichi Hirotani, and Nobuyuki Kawai (Institute of Physical and Chemical Research, Saitama, Japan) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 423-426 (For primary document see N90-25711 19-89)
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The rapid burster (MXB1730-335) is a distinct X-ray burster from which both type I and II bursts are observed. A model for

the rapid burster based on the observed properties of type II bursts is proposed. In the model the rapid burster is assumed to be a binary system involving a magnetized accreting neutron star. The magnetic field strength of the neutron star is discussed. It is estimated to be B approximately 10 to the 8th power G at the neutron star surface. The high energy power law component observed in the spectra of type II bursts is presented. In the model high energy X-ray photons are produced through the Compton scattering with electrons in the accretion flow. It is also shown that the model spectrum fits with the observed one quantitatively. ESA

N90-25783# Ceskoslovenska Akademie Ved, Ondrejov.
THE LONG-TERM OPTICAL BEHAVIOUR OF X PER = 3U 0352+30
R. Hudec and K. Raetz (Arbeitskreis Veraenderliche Sterne, Herges-Hallenberg, German D.R.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 427-431 Sponsored in part by Academy of Sciences, German D.R. and Sonneberg Observatory, German D.R. (For primary document see N90-25711 19-89)
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The variable star X Per, an optical counterpart to the X-ray binary 3U 0352+30, was investigated. Photographic plates taken at the Sonneberg and Ondrejov Observatories and numerous visual observations provided by amateur astronomers were used. The data set corresponds to the time interval 1933 to 1988. The investigations allow long-term light changes to be analyzed. The most significant results are given and discussed. The possible very long term light changes with amplitude of nearly 0.6 in B and an apparent period of nearly 40 years were revealed. ESA

N90-25784# Tuebingen Univ. (Germany, F.R.). Lehr- und Forschungsbereich Theoretische Astrophysik.
ACCRETION ONTO NEUTRON STARS: RADIATIVE TRANSFER IN A STRONG GRAVITATIONAL FIELD
U. Kraus, A. Rebetzky, H. Herold, H.-P. Nollert, T. Maile, and H. Ruder *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 433-436 (For primary document see N90-25711 19-89)
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The beam shape of binary X-ray pulsars is partly determined by the transfer of X-rays through accreting magnetized plasma. An extension of the iterative scattering method of radiative transfer is reported. It allows incorporation of gravitational light deflection into a radiative transfer calculation and includes the effects of plasma bulk motion. A model of an accretion column consistent with an exterior Schwarzschild metric for interactive scattering method inputs is outlined. ESA

N90-25785# Sao Paulo Univ. (Brazil). Inst. Astronomico e Geofisico.
Be/X RAY SOURCES
E. Janot-Pacheco *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 437-438 (For primary document see N90-25711 19-89)
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The X-ray luminosities observed in eight Be/X-ray systems are explained. The observed and calculated maximum X-ray luminosities for such systems are compared assuming that the neutron stars are in equatorial orbits and accrete from dense, slowly expanding, Be envelopes responsible for the IR excess and Balmer emission. ESA

N90-25786# Leicester Univ. (England). X Ray Astronomy Group.
THE X RAY DIP SOURCE 4U 1624-49
Mark H. Jones and M. G. Watson *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 439-444 (For primary document see N90-25711 19-89)
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The results from EXOSAT and Ginga observations of the 21 hour period dip source 4U 1624-49 are presented. Two aspects of the time variability are considered. The behavior of the fractal dimension of the dip light curves as a function of dip activity are studied. The spectral characteristics of the source outside and during dip events are discussed. The non-dip state shows intermittent flaring activity which is modeled. The spectral analysis of the dips is complicated by the column density of the absorbing clouds. The implications of this effect are discussed, and it is found that the metallicity of the absorbing materials is 0.9 + or - 0.4 of the normal cosmic value. ESA

N90-25787# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
THE PROBLEM OF DEAD LAYER IN GAMMA RAY BURST SPECTRA RECORDED WITH NaI OR CsI CRYSTALS
E. Jourdain, M. Niel, and J. P. Roques *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 445-446 (For primary document see N90-25711 19-89)
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A Monte Carlo program is used for simulating a dead layer on NaI crystals and to calculate the resultant count spectra in different cases. A study of the dead layer effect is presented. Applications to some observed gamma-ray burst spectra are performed. The importance of such a phenomenon in the gamma spectral analysis is underlined. ESA

N90-25788# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
EXOSAT OBSERVATIONS OF THE PULSE PROFILE OF HER X-1 DURING INTERMEDIATE INTENSITY STATES IN A 35-DAY CYCLE IN 1985
Peter Kahabka *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 447-452 (For primary document see N90-25711 19-89)
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In 1984 and 1985 Her X-1 was observed by EXOSAT during two 35 day cycles. A pulse profile change was observed and modeled by a free precessing neutron star. It is shown that the progressive intensity reduction from the left to the right pulse flank of the main pulse can be described by a highly ionized obscurating screen at the inner magnetospheric boundary of the accretion disk. There is evidence that the neutron Her X-1 performs a free precession movement. ESA

N90-25789# Institute of Physical and Chemical Research, Saitama (Japan).
GINGA OBSERVATIONS OF SS 433
Nobuyuki Kawai *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 453-458 (For primary document see N90-25711 19-89)
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The X-ray eclipses of SS433 were observed by Ginga on three occasions in May of 1987, 1988 and 1989. It was found that: the X-ray eclipse is always partial, and it occurs at a phase in good agreement with optical minimum; there is a small jitter in the binary phase of the X-ray ingress and egress; the X-ray flux as well as its eclipse fraction changes depending on the precession phase; the X-ray flux was low and the eclipse was shallow at the observations in 1988 and 1989 when the angle between the jets and the line of sight is close to 90 degrees; the intrinsic width of the intense emission line at approximately 7 keV is large, and

changes with the jet precession phase; the emission line consists of at least two components with small and large width. The presence of Compton scattering medium is suggested. ESA

N90-25790*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EINSTEIN SSS AND MPC OBSERVATIONS OF AQL X-1 AND 4U1820-30
R. L. Kelley, D. J. Christian, R. J. Schoelkopf (California Inst. of Tech., Pasadena.), and J. H. Swank *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 459-465 (For primary document see N90-25711 19-89)
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The results of timing and spectral analyses of the X-ray sources Aql X-1 (X1908+005) and 4U1820-30 (NGC6624) are reported using data obtained with the Einstein SSS (Solid State Spectrometer) and MPC (Monitor Proportional Counter) instruments. A classic type I burst was observed from Aql X-1 in both detectors and a coherent modulation with a period of 131.66 + or - 0.02 ms and a pulsed fraction of 10 percent was detected in the SSS data. There is no evidence for a loss of coherance during the approximately 80 sec when the burst is observable. The 2 sigma upper limit on the rate of change of the pulse period is 0.00005s/s. It is argued that an asymmetrical burst occurring on a neutron star rotating at 7.6 Hz offers a plausible explanation for the oscillation. The data from 4U1820-30 show that the amplitude of the 685 sec modulation, identified as the orbital period, is independent of energy down to 0.6 keV. The SSS data show that the light curve in the 0.6 to 4.5 keV band is smoother than at higher energies. ESA

N90-25791# Tuebingen Univ. (Germany, F.R.). Astronomisches Institut.
HARD X RAY PULSES FROM VELA X-1
E. Kendziorra, B. Mony, M. Maisack, R. Staubert, S. Doebereiner, J. Englhauser, W. Pietsch, C. Reppin, J. Truemper, and V. V. Efremov (Academy of Sciences, USSR, Moscow) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 467-471 (For primary document see N90-25711 19-89)
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The high mass X-ray binary Vela X-1 (4U 0900-40) was observed with the high energy X-ray experiment on board the Kvant module in Nov. 1988 and Feb. 1989 for a total of 8 hours. Individual pulses during an active state were observed up to 70 KeV. The time averaged spectra for four binary phases were fitted with a power law plus exponential cutoff. During the flare state at binary phase 0.16 the spectrum is slightly softer. In all but the flare observation a significant excess flux between 70 and 96 KeV is observed. The spectral feature can be fitted with an emission line around 85 KeV, possibly a cyclotron line. The observed width is consistent with the energy resolution of the detector. ESA

N90-25792# Amsterdam Univ. (Netherlands). Inst. of Astronomy.
THE 3S0114+65 AND ITS PECULIAR COMPANION
M. H. vanKerkwijk and L. B. F. M. Waters (University of Western Ontario, London.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X ray Astronomy. Volume 1: X ray Binaries Nov. 1989 p 473-475 (For primary document see N90-25711 19-89)
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A series of spectra of the optical counterpart of 3S0114+65, taken in November 1986, show a sudden increase of a factor three in the equivalent widths of the hydrogen lines. Spectra taken in 1987 show only mild variability, such as changes in the line profiles of the hydrogen lines. EXOSAT observations of the source show a variable X-ray intensity. The spectrum is hard, with variable adsorption. The possible pulse period of 14.9 minutes is not confirmed. The nature of 3S0114+65 remains unclear. ESA

N90-25793# Columbia Univ., New York, NY. Dept. of Physics.
HARD X RAYS WITH A POWER LAW SPECTRUM FROM A NEUTRON STAR ACCRETING THROUGH THE RELATIVISTIC GAP
Wlodzimierz Kluzniak and James R. Wilson (Lawrence Livermore National Lab., CA.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 477-478 (For primary document see N90-25711 19-89)
(Contract W-7405-eng-48; NSF AST-86-02831)
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A weakly magnetized neutron star of radius substantially smaller than the radius of the marginally stable orbit is investigated. It is found to emit hard X rays if it undergoes disk accretion with mass transfer rates typical in X ray binaries. A typical spectrum is shown; between approx. 6 KeV and approx. 200 KeV, it is a power law of photon index alpha = -2.2. ESA

N90-25794# Sternberg Astronomical Inst., Moscow (USSR).
EXPLORATION OF JET PHYSICS WITH SOME APPLICATIONS TO SS 433
E. V. Koval and N. I. Shakura *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 479-482 (For primary document see N90-25711 19-89)
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Theoretical X ray spectra in the model of homogenous jets and the model of jets consisting of separated expanding spherical blobs were calculated. Both models describe satisfactorily the continual component (2 to 20 KeV) of X ray spectra of SS 433. Physical parameters of the models were evaluated. ESA

N90-25795# Nagoya Univ. (Japan). Dept. of Astrophysics.
NEW X RAY PULSARS DISCOVERED WITH THE GINGA SATELLITE
Katsuji Koyama and Y. Takeuchi *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 483-484 (For primary document see N90-25711 19-89)
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The discovery of six X ray pulsars and several candidates of X ray pulsars is reported. These new pulsars and candidates show a high concentration towards the Scutum region. The pulse profiles, in several energy bands and X ray spectra of these new X ray pulsars are presented. The best fit models are given. The model used is a power law plus exponential cut (if necessary). The positions and best fit parameters of the X ray pulsars are shown. ESA

N90-25796# Tata Inst. of Fundamental Research, Bombay (India).
LONG PERIOD VARIATIONS IN HIGH MASS X RAY BINARIES AND THEIR POSSIBLE RELATIONSHIP WITH SU UMa STARS
P. K. Kunte and A. R. Rao *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 485-487 (For primary document see N90-25711 19-89)
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The long period X ray variability of X ray binaries (H M X R B) and the long period outbursts observed in many SU UMa type cataclysmic variables are examined. It is the nonradial g-mode oscillations of the primary star in these binaries. A correlation is obtained between the long periods and the binary periods of H M X R Bs and SU UMa stars are derived. ESA

N90-25797# Barcelona Univ. (Spain). Dept. Fisica de l'Atmosfera, Astronomia i Astrofisica.
NEUTRON STAR FORMATION IN LOW-MASS BINARY SYSTEMS
Javier Labay, Domingo Garcia, Ramon Canal, and Jordi Isern (Consejo Superior de Investigaciones Cientificas, Blanes, Spain) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 489-491 (For primary document see N90-25711 19-89)
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The formation of low mass X-ray binaries containing a neutron star as the compact X-ray source is discussed. The problem presented by the standard mechanism and concerning the disruption of the binary system is investigated. Two solutions are possible: either the neutron star forms isolately, and only later binds with a relatively low-mass star, or it forms in situ. It is shown that the accretion induced collapse of CO white dwarfs is possible for a limiting range of initial conditions. In contrast, ONeMg white dwarfs appears less likely. ESA

N90-25798# Calgary Univ. (Alberta). Dept. of Physics.
PROPERTIES OF CIRCUMSTELLAR MATTER IN GX301-2 OBSERVED BY TENMA
D. A. Leahy and Masaru Matsuoka (Institute of Physical and Chemical Research, Tokyo, Japan) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 493-498 Sponsored by Canadian Natural Sciences and Engineering Research Council (For primary document see N90-25711 19-89)
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High resolution spectral observations of the X-ray pulsar GX301-2 by Tenma are analyzed. The X-ray spectrum and the changes that occur as a function of pulse phase GX301-2 has the largest observed column densities of all the X-ray pulsars. The effects caused by scattering in the circumstellar material are modeled in part analytically and in part by Monte Carlo simulations. Scattering effects can account for a significant part of the observed variations in spectrum. The source of radiation from the neutron star must have intrinsic variations. The variations of the spectrum and its implications are discussed. ESA

N90-25799# Oxford Univ. (England). Dept. of Astrophysics.
A MODEL FOR 1/f-TYPE VARIABILITY IN ACTIVE GALACTIC NUCLEI
Harry J. Lehto *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 499-503 (For primary document see N90-25711 19-89)
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The power spectra of a sum of shot noises is calculated. The logarithmic power spectral slopes of -1 to -2 which are produced last for several decades, similar to published power spectra of time series of several X ray active galaxies. Because of a low frequency flattening, and high frequency steepening of the spectrum, the total power in the spectra remains finite. To explain the published power spectra, time ranges of 3000 in the decay times of pulses are required. The pulse activity region spans at least 3.5 orders of magnitude. The variability timescales are not connected to the light travel timescales. Assuming a pulse creation and an emission mechanism, other constraints to the physical conditions around the central engine can be set. ESA

N90-25800# California Univ., Berkeley. Dept. of Physics.
SPECTRAL SIGNATURES OF X RAY PHOTOIONIZED NEBULAE
Duane A. Liedahl, Steven M. Kahn, Albert L. Osterheld, and William H. Goldstein (Lawrence Livermore National Lab., CA.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 505-509 (For primary document see N90-25711 19-89)
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The applicability of the tools of X ray line spectroscopy into regions of the physical parameter space not addressed by existing plasma emission codes is considered. Atomic models for the ions Fe XVI to XIX are calculated assuming conditions appropriate to X ray photoionized cosmic sources. The resulting L-shell line spectra are easily distinguished from coronal spectra and provide diagnostics of the dominant level population mechanisms operating in the line emitting regions. Einstein objective grating spectra from the low mass X ray binaries, Cyg X-2, GX9+9, and 4U1820-30, may be consistent with predictions of spectra from X ray photoionized sources. ESA

N90-25801# Science Research Council, Chilton (England). Astrophysics Div.
THE OPTICAL LIGHT CURVE OF CYGNUS X-1
C. Lloyd and E. N. Walker (Royal Greenwich Observatory, Herstmonceux, England) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 511-514 (For primary document see N90-25711 19-89)
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An analysis of the optical light curve of the massive X ray binary and black hole candidate Cygnus X-1 is presented. It is based on broad band UBV photometry covering the period 1972 to 1985. The principal photometric variation has a period of 5.59982 + or - 0.00005 days and is sensibly the same as the orbital period. The existence of a second period in the optical variations at 294.3 + or - 0.5 is confirmed. The shape of the binary 5.6 day light curve in U, B and V is clearly shown to be a function of phase in the 294 day period, with most of the activity restricted to phases -0.25 to 0.25 of the 5.6 day cycle. The minimum at phase 0.5 of the 5.6 day cycle is essentially constant throughout the 294 day cycle. A search for period changes in the 5.6 day cycle shows no conclusive evidence of change. ESA

N90-25802*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
BBXRT OBSERVATIONS OF X RAY BINARIES
F. E. Marshall *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 515-517 (For primary document see N90-25711 19-89)
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The Broad Band X Ray Telescope (BBXRT) is a new X ray spectrophotometer scheduled for launch Apr. 26, 1990, for a 10 day mission aboard the Space Shuttle Columbia. High quality spectra between 0.3 and 12 keV of about 100 different sources are expected. BBXRT has the best energy resolution for examining features due to the K-shell of Fe, seen in the spectra of X ray binaries. The resolution is sufficient to make sensitive searches for broadened emission lines, to resolve multiple features, and to determine the ionization state of the emitting plasma by measuring line energies. Simulated spectra of several sources are presented. ESA

N90-25803# Osservatorio Astronomico, Naples (Italy).
ON THE NATURE OF THE 1980 OUTBURST OF THE Be/X RAY BINARY A0535+26=HDE 245770
D. deMartino, L. B. F. M. Waters, F. Giovannelli, and P. Persi (Consiglio Nazionale delle Ricerche, Frascati, Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 519-520 (For primary document see N90-25711 19-89)
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The nature of a strong outburst of the Be/X ray binary A0535+26/HDE 245770 which occurred in 1980 and not in phase with the orbital period is investigated. This activity is interpreted in

terms of enhanced mass loss from the optical counterpart. The X ray emission is studied in terms of direct accretion from the equatorial wind of the optical star. The wind velocity profile and the wind density distribution are derived. The resulting mass loss rate is in agreement with the observed X ray luminosity. ESA

N90-25804# Osservatorio Astronomico, Naples (Italy).
A SHELL EJECTION MODEL FOR OPTICAL LIGHT VARIATIONS IN Be STARS: APPLICATION TO Be/X RAY BINARIES
D. deMartino, L. B. F. M. Waters, F. Giovannelli, C. Bartolini, A. Guarnieri, and C. Piccioni (Bologna Univ., Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 521-523 (For primary document see N90-25711 19-89)
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A model for light variations in Be stars where changes in the mass loss rate occur in the form of shell ejections is presented. Optical variations of the order of tenths of magnitude on a timescale ranging from days to several weeks are predicted by the model. A correlation between Be/X ray binaries optical light variations and X ray activity is investigated. An application to the Be/X ray binary A0535+26/HDE 245770 is presented. ESA

N90-25805*# Northwestern Univ., Evanston, IL. Dept. of Physics and Astronomy.
GAMMA RAY BURSTS FROM MAGNETOSPHERIC PLASMA OSCILLATIONS **c93**
Fulvio Melia *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 525-530 Sponsored by NASA, Washington and Sloan (Alfred P.) Foundation (For primary document see N90-25711 19-89)
(Grant NSF PHY-88-57218)
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Neutron star Magnetospheric Plasma Oscillations (MPO), can account for the energetics, decay time scale, and spectra of typical Gamma Ray Bursts (GRBs). The soft photon source is likely to be due to backwarming of the reprocessing boundary by the incipient gamma rays. It is shown that the observed fraction of bursts displaying low energy absorption features may be understood in the context of an MPO model. Moreover, it is found that GRB spectra should display these cyclotron lines about 18 percent of the time, which is consistent with the KONUS and Ginga sets of data. ESA

N90-25806# Osaka Univ., Toyonaka (Japan). Dept. of Physics.
IS THE HARD TAIL OF X RAYS FROM GX339-4 A COMPTON SCATTERING COMPONENT **c93**
Sigenori Miyamoto, Shunji Kitamoto, and Kazuhiro Kimura *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 531-536 (For primary document see N90-25711 19-89)
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The Ginga observations of GX333-4 are examined. Two components were detected in the X ray spectrum: the X rays from an accreting disk and a hard tail component, whose energy spectrum can be represented by a Compton scattering model. The X rays showed various time scale variations. These variable components can be interpreted to be due to the hard tail. The observed lag time between the time variations of high and low energy X rays shows a particular plateau structure together with the structure of the increasing lag time with Fourier period, and the time variation of the X rays of 2.3 to 4.6 keV is most advanced. ESA

N90-25807# Palermo Univ. (Italy). Ist. di Fisica.
SIMULATION OF THE BOUNDARY LAYER IN ACCRETION DISKS WITH THE SPH METHOD
D. Molteni, G. Principato, and G. Giannone *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 537-540 (For primary document see N90-25711 19-89)
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The boundary layer between the accretion disk formed by gas falling onto a compact star is considered. The description of the structure of the region of transition from highly supersonic to subsonic motion is investigated. Numerical solutions to understand the physical processes operating in this region are presented. The Smoothed Particle Hydrodynamics (SPH) method is used to integrate the equations of the gas and radiation. Radiation is treated in the flux limited diffusion approximation. Simulations of the 3-D motion of the gas are presented. ESA

N90-25808# Tuebingen Univ. (Germany, F.R.). Astronomisches Institut.
HIGH ENERGY X RAY OBSERVATIONS OF GX 1+4 WITH HEXE **c93**
B. Mony, E. Kendziorra, M. Maisack, R. Staubert, S. Doebereiner, J. Englhauser, W. Pietsch, C. Reppin, J. Truemper, and V. V. Efremov (Academy of Sciences, USSR, Moscow) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 541-544 (For primary document see N90-25711 19-89)
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Two observations with the High Energy X ray Experiment (HEXE) on board the Soviet Kvant module and performed on the X ray pulsar GX 1+4(4U1728-24) are reported. During the first observation on Oct. 31, 1987 the luminosity in the energy range 20 to 60 keV was 2 x 10 (exp 37) erg/sec. For the second observation, lasting from 23 to 27 Sep. 1988 there is no reliable aspect information available. The phase averaged spectra of both observations are well fitted by a thermal bremsstrahlung. A comparison to spectra, gained during the high state of GX 1+4, shows that the spectrum is now significantly harder. The timing analysis using an epoch folding method allowed obtaining of pulsational periods. The pulse periods fit well together with periods determined by Ginga, defining a long term spin down of GX 1+4. ESA

N90-25809# Observatoire de Besancon (France).
OPTICAL EMISSION FROM THE HIGH INCLINATION X RAY TRANSIENT EXO 0748-676 **c93**
C. Motch, Holger Pedersen, Sergio A. Ilovaisky, Claude Chevalier (Observatoire de Paris-Meudon, France), and M. Mouchet *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 545-549 (For primary document see N90-25711 19-89)
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The analytical of optical charged coupled device and high time resolution photoelectric photometry of EXO 0748-676 are presented. They were collected from Feb. 1985 until Mar. 1987 at the European Southern Observatory. During the 1985 Feb. to Mar. decay from outburst, the V band flux near light curve maximum at phase 0.5 was positively correlated with the 1 to 20 keV flux measured by EXOSAT. Since its discovery the optical counterpart oscillated several times between low and high optical states which are the clear equivalent states identified in X-rays. In 1985 the optical photometric light curve exhibits shape variations which are correlated with the mean optical/X-ray flux and with X-ray dip activity. The interpretation of the optical light curve is discussed and present observational evidences revealing the effects of high systemic inclination on X-ray persistent, burst and optical emissivity. ESA

N90-25810# Tuebingen Univ. (Germany, F.R.). Lehr- und Forschungsbereich Theoretische Astrophysik.
RELATIVISTIC LIGHT BENDING NEAR NEUTRON STARS
H.-P. Nollert, U. Kraus, A. Rebetzky, H. Herold, T. Maile, and H.

Ruder *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 551-556 (For primary document see N90-25711 19-89)
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The deflection of light ray emitted on or near the surface of a neutron star is investigated. A picture of the star as it would appear on a screen far away from the star is computed, giving an impression of the effects of light bending. This geometrical data is combined with emission models in order to obtain frequency dependent pulse shapes. They are compared to the pulse shapes as they would turn out in flat space-time. Relativistic light bending generally tends to flatten the pulse shapes, but in certain cases a new peak may appear, which is totally absent in the non-relativistic case. ESA

N90-25811# Hulburt (E. O.) Center for Space Research, Washington, DC.
METHODS FOR PROBING QUASI-PERIODIC OSCILLATIONS ON SHORT TIME SCALES
J. P. Norris, P. Hertz, K. S. Wood, B. A. Vaughan, P. F. Michelson, Kazuhisa Mitsuda, and T. Dotani (Tokyo Univ., Japan) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 557-561 (For primary document see N90-25711 19-89)
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Optimal filter analysis techniques are employed in order to set constraints on the nature of possible relationships between Low Frequency Noise (LFN) and Quasi-Periodic Oscillations (QPOs) in GX5-1 on time scales near the QPO coherence length. Simulations afford comparison with theory and calibrate the high noise bias. Models in which LFN shots modulate sinusoidal QPOs are explored for shot rates approx. 400 Hz and shot clustering fractions approx. 50 percent. The models are found to be incompatible with the data. ESA

N90-25812# Potchefstroom Univ. for Christian Higher Education (South Africa). Dept. of Physics.
ORBITALLY MODULATED VHE GAMMA RAYS FROM CEN X-3 **c93**
A. R. North, C. Brink, K. S. Cheng (Hong Kong Univ.), O. C. deJager, H. I. Nel, and B. C. Raubenheimer *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 563-566 (For primary document see N90-25711 19-89)
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The emission of Very High Energy (VHE) gamma rays from Cen X-3 in the orbital phase interval between 0.7 to 0.8 is discussed. This object was observed during 1986, 1988, and 1989 using the Potchefstroom (South Africa) TeV gamma ray telescope. The analysis of the data confirms this pulsed emission in the orbital phase interval 0.7 to 0.8. This modulation is probably due to an accretion wake that crosses the line of sight at an orbital phase of about 0.75 presenting the necessary target material for the production of this emission. ESA

N90-25813# Birmingham Univ. (England). Dept. of Space Research.
IDENTIFICATION OF GALACTIC BULGE X RAY BURSTS WITH PERSISTENT X RAY COUNTERPARTS **c93**
T. G. Patterson, G. K. Skinner, A. P. Willmore, O. Emam, A. C. Brinkman, J. Heise, J. J. M. intZand, R. Jager, Rashid A. Sunyaev, and E. Churazov (Academy of Sciences, USSR, Moscow) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 567-572 (For primary document see N90-25711 19-89)
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Details of five X ray bursts seen during a survey of the galactic bulge are presented. They were made with the coded-mask imaging X ray spectrometer between Oct. 1988 and Apr. 1989. The bursts are shown to originate from the previously known burst sources 1702-429, 1728-337 and from close to SLX1744-299. The results which showed that there are in fact two adjacent sources, SLX1744-299 and SLX1744-300, and that it is the latter which is a burst source, are confirmed. ESA

N90-25814# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
EXOSAT DEEP EXPOSURE OF THE LMC X-4 REGION **c93**
W. Pietsch, C. Rosso, and Konrad Dennerl *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 573-577 (For primary document see N90-25711 19-89)
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EXOSAT observations of the LMC X-4 region, obtained with the low energy X ray telescope and cylindrical mirror analyzer and 3000A Lexan filter are presented. They are combined into one image. LMC X-4 and all the other Einstein sources in the field (the supernova remnants N49 and N63A and the Me star LHG57) are detected in the EXOSAT image and in addition the X ray source EXO 053109-6609.2. This EXOSAT LMC (Large Magellanic Cloud) transient is only visible during 1983. The star HD 37935, the emission nebulae N55 and N55A, a stellar association near N62A, the star cluster NGC2003 are not detected due to UV radiation leaking through the filter. ESA

N90-25815# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Astrofisica Spaziale.
SEARCH OF THE OPTICAL COUNTERPART OF THE X RAYS SOURCE 1H 0521+373
V. F. Polcaro, C. LaPadula, F. Giovannelli, M. Ferrari-Toniolo, P. Persi, R. K. Manchanda, L. Norci, C. Rossi, I. M. Golinnskaya, and V. G. Kurt (Academy of Sciences, USSR, Moscow) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X ray Binaries Nov. 1989 p 579-582 Sponsored in part by Piano Spaziale Nationale and CNR/USSR Academy of Sciences Collaboration Program (For primary document see N90-25711 19-89)
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The analysis of the X-ray, ultraviolet, optical and infrared observations of the two peculiar stars BD+37 deg 1146 and BD+37 deg 1160 are presented. They are included in the error box of the hard X-ray source 1H 0621+373. The star BD+37 deg 1160 shows rapidly variable emission features in its optical spectrum and infrared excess. Its association with the X-ray source is suggested. A remarkable similarity of the optical spectrum with that of X Per further support this identification. ESA

N90-25816# Amsterdam Univ. (Netherlands). Inst. of Astronomy.
ON THE NATURE OF LOW-LUMINOSITY Be/X RAY BINARIES **Abstract Only**
O. R. Pols, J. Cote, and L. B. F. M. Waters (University of Western Ontario, London.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 583 (For primary document see N90-25711 19-89)
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The existence of a class of low luminosity X ray sources, consisting of a Be star and a white dwarf, is proposed. ROSAT is expected to discover several dozen of these systems. They are expected to outnumber the classical Be/X ray binaries by a factor of about 10. ESA

N90-25817# Birmingham Univ. (England). School of Physics and Space Research.
SELF-CONSISTENT COMPTONISED MODELS FOR THE SPECTRA OF LOW MASS X RAY BINARIES
T. J. Ponman, A. J. Foster, and R. R. Ross (College of the Holy Cross, Worcester, MA.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries

Nov. 1989 p 585-591 (For primary document see N90-25711 19-89)
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Models concerning an injected spectrum from a central point source propagating outward through a surrounding envelope, whose temperature is determined by the local radiation field, were developed. The spectrum is modified by Compton scattering during escape through the cloud. A grid of such models was constructed and used to fit EXOSAT data from eleven low mass X ray binaries. It is found that the comptonized model fits the spectral continuum observed in these sources and several physically interesting correlations amongst the fitted parameters are discovered. ESA

N90-25818# Sternberg Astronomical Inst., Moscow (USSR).
ON THE PROBLEM OF THE SUPERNOVA EXPANSION LAW IN THE LARGE MAGELLANIC CLOUD
M. E. Prokhorov and N. I. Shakura *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 593-594 (For primary document see N90-25711 19-89)
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An attempt to explain the rapid linear expansion law for observed supernova remnants in large Magellanic cloud is presented. Their expansion in a stellar wind of the pre-supernova star instead of homogeneous interstellar medium is considered. ESA

N90-25819# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany, F.R.).
THE PULSED LIGHT CURVE OF VELA X-1
B. C. Raubenheimer (Potchefstroom Univ. for Christian Higher Education, South Africa) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 595-599 (For primary document see N90-25711 19-89)
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By using the low energy and medium energy data from the EXOSAT observatory the investigation of the 283 second pulse profile of Vela X-1 in its dependence on spin and orbital phase as well as energy are performed. Pulsed emission was found down to the lowest energy measureable. A pulse phase analysis showed that the pulse profiles are independent of the orbital phase and on time scales larger than 4 hours. It is shown that the five low energy peaks evolve gradually out of the double peak structure at high energies and that the transition occur in the 6 to 20 keV range. Comparison with models led to the conclusion that the neutron star is a near-orthogonal rotator with the magnetic axis close to the line of sight and that the X rays must be produced in slightly asymmetric accretion columns at the magnetic poles. A magnetic field of (2 to 5) x 10 (exp 12) G is found. ESA

N90-25820# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
THE ROLE OF COMPTONISATION IN ENERGY SPECTRA OF STANDARD QPO-SOURCES
N. S. Schulz and R. A. M. J. Wijers (Amsterdam Univ., Netherlands) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 601-606 (For primary document see N90-25711 19-89)
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The spectral variability in the color-color diagram in Quasi-Periodic Oscillation (QPO) sources is discussed. The blackbody spectra comptonized by a hot electron plasma also fit the EXOSAT spectra of these sources. A parametrization of the color-color diagram indicates systematical parameter variations in all spectral branches. They can be decomposed in a variation of a single photon source and an extended hot electron cloud. The temperature of the photon source varies between 0.5 and 1.0 keV, the electron cloud has scattering depths between 3 and 7 and temperatures from 2.0 to 5.0 keV. Links to QPO models on the horizontal spectral branch and physical consequences of the model are discussed. ESA

N90-25821*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GINGA OBSERVATIONS OF DIPPING LOW MASS X RAY BINARIES
Alan P. Smale, Koji Mukai, O. Rees Williams, Mark H. Jones, Arvind N. Parmar, and Robin H. D. Corbet (Tokyo Univ., Japan) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 607-616 (For primary document see N90-25711 19-89)
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Ginga observations of several low mass X ray binaries displaying pronounced dips of variable depth and duration in their X ray light curves are analyzed. The periodic occultation of the central X ray source by azimuthal accretion disk structure is considered. A series of spectra selected by intensity from the dip data from XB1916-053, are presented The effects of a rapidly changing column density upon the spectral fitting results are modeled. EXO0748-676 was observed in March 1989 for three days. The source was found to be in a bright state with a 1 to 20 keV flux of 8.8 x 10 (exp -10) erg/sqcms. The data include two eclipses, observed with high time resolution. ESA

N90-25822*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TIMING ANALYSIS OF BINARY X RAY PULSARS OBSERVED BY HEAO 1
Y. Soong and J. H. Swank *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 617-620 (For primary document see N90-25711 19-89)
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Timing analysis of the pointed observations of 5 selected binary X ray pulsars, in two categories of disk-fed and wind-fed sources, by HEAO 1 A-2 is reported. The power spectral analysis was performed on the data in the frequency range from approx. 1 MHz to 6.25 Hz. The coherent signal of the pulsation, the continuum of the power spectrum, varies in time and differs among sources. Quasi-Periodic Oscillation (QPO) is probably related to a fast spinning but weakly magnetized neutron star in the low mass X ray binaries. QPO was searched for in this frequency range to see if scaling laws exist among these two systems which may have possessed different order of magnitude of magnetic field strengths and the inner disk radii. One possible QPO is found centering at 0.062 Hz in 4U0115+63 during a flare. ESA

N90-25823*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
IONIZATION EFFECTS IN THE RADIATIVE DRIVING OF STELLAR WINDS IN MASSIVE X RAY BINARY SYSTEMS
Ian R. Stevens *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 621-625 (For primary document see N90-25711 19-89)
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Massive X ray binaries consist of an early type primary lossing mass via a strong stellar wind driven by the stars radiation field, and an accreting neutron star companion. The X rays from the neutron star affect the wind dynamics by changing the temperature and ionization structure. The effect of the accretion powered X rays on the radiative line force that drives the stellar wind is calculated. The consequences of these calculations for the wind dynamics in massive X ray binaries is discussed. ESA

N90-25824# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
X RAY BURSTER SPECTRA IN THE STATE OF THE PERSISTENT FLUX LEVEL. TWO TEMPERATURE MODELS OF THE NEUTRON STAR ATMOSPHERE
Rashid A. Sunyaev and Lew Titarchuk *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 627-631 (For primary document see N90-25711 19-89)
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The X ray emission from accretion disks in low mass X ray binaries is discussed. The effects of transfer radiation and comptonization are taken into account. It is assumed that the atmosphere of a neutron star consists of two layers. The upper one is much hotter than the lower one. The presence of accretion is required. Self-consistent calculations of the spectrum of outgoing radiation for a wide range of luminosities and temperatures of the hot upper layer are presented. The observations proved to be consistent with the models whose hot layer temperature is of the order of 4 keV and the luminosity level is relatively low. ESA

N90-25825# Academy of Sciences (USSR), Moscow. Space Research Inst.
X RAY OBSERVATIONS OF THE LMC FIELD BY THE TTM INSTRUMENT ONBOARD THE KVANT MODULE: NOVEMBER 1988 TO JUNE 1989
Rashid A. Sunyaev, E. Churazov, M. R. Gilfanov, V. Loznikov, N. Yamburenko, G. K. Skinner, T. G. Patterson, A. P. Willmore, O. Emam, and A. C. Brinkman (Space Research Organization Netherlands, Utrecht.) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 633-640 (For primary document see N90-25711 19-89)
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The results of the Large Magellanic Cloud (LMC) observations in the 2 to 30 keV band by the coded mask imaging spectrometer instrument of the Mir-Kvant X ray observatory are presented. The observations were performed during the period Nov. 1988 to Jun. 1989. An upper limit on the flux from supernova SN1987A is found to be 0.6 mCrab in this band. The results of monitoring and spectral observations of LMC X-1, LMC X-2, LMC X-3, LMC X-4 and PSR0540-693 are given. ESA

N90-25826# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
A NEW TRANSIENT X RAY BURST SOURCE NEAR GX 1+4 **c93**
Rashid A. Sunyaev, E. Churazov, M. R. Gilfanov, V. Loznikov, N. Yamburenko, G. K. Skinner, T. G. Patterson, A. P. Willmore, O. Emam, and A. C. Brinkman (Space Research Organization Netherlands, Utrecht.) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 641-646 (For primary document see N90-25711 19-89)
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The observations of the GX1+4 field on Aug. 16 1989 are reported. During these observations, the cooled mask imaging spectrometer instrument of the Mir-Kvant observatory discovered a new transient X ray burster. The persistent flux in the 2 to 27 keV band from this source varied from 50 to 100 millicrabs. Several bursts with durations of 10 to 20 s and peak flux up to 0.6 Crab were detected in the period from 16 to 31 Aug. ESA

N90-25827# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Astrophysik.
ASTROPHYSICAL IMPORTANCE OF THE SLIM ACCRETION DISKS **c90**
Ewa Szuszkiewicz *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 647-651 (For primary document see N90-25711 19-89)
Avail: NTIS HC A99/MF E06; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The astrophysical importance of the new class of theoretical models for accretion disks concentrating mainly on the applications to active galactic nuclei are discussed. The slim accretion disks model describes several important astrophysical processes which dominate the properties of the flow close to a central compact object (a very compact neutron star or a black hole). ESA

N90-25828# Sternberg Astronomical Inst., Moscow (USSR).
NEW RESULTS OF NUMERICAL SIMULATIONS OF X RAY BINARIES EVOLUTION
V. Tatarintzeva, V. Lipunov, E. Osminkin, and M. E. Prokhorov *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 653-656 (For primary document see N90-25711 19-89)
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The results of numerical calculations of the evolution of Neutron Star (NS) in close binaries are presented. The detailed analysis of the NS evolution uses accurate evolutionary tracks for optical companion. By using less accurate evolutionary tracks for normal stars the simulation of the joint evolution of 100,000 binaries is performed. The evolution of total X ray luminosity caused by accreting neutron stars was calculated for different types of galaxies. ESA

N90-25829# Osservatorio Astronomico, Turin (Italy).
EXOSAT OBSERVATION OF THE PULSAR PSR 1509-58
E. Trussoni, W. Brinkmann, H. Oegelman, G. Hasinger, B. Aschenbach (Max-Planck-Inst. fuer Extraterrestrische Physik, Garching, Germany, F.R.), and A. Ferrari *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 657-659 (For primary document see N90-25711 19-89)
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The results of an EXOSAT observation of the radio and X ray pulsar PSR 1509-58, associated with the supernova remnant MSH 15-52 are presented. In the energy range 1.5 to 10 keV the radiation flux detected by the medium energy instrument was fitted with a power law. The period of the pulsar was measured with a value of approx. 0.150362 s, in agreement with the value obtained from the low energy data (energy range 0.02 to 2.5 keV), and with extrapolation from previous observations at X and radio frequencies. ESA

N90-25830# Leicester Univ. (England). Dept. of Physics and Astronomy.
THE 3A1954+319: A POSSIBLE SUPERGIANT X RAY BINARY
R. W. Tweedy, R. S. Warwick, and R. Remillard (Massachusetts Inst. of Tech., Cambridge.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 661-663 (For primary document see N90-25711 19-89)
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Results from Ginga show that the unidentified X ray source 3A1954+319 may be a supergiant binary system. Its light curve is dominated by flaring on timescales of several minutes, with variations in intensity up to a factor ten. There are rapid changes in the spectral hardness. The X ray spectrum above 4 keV can be modeled as a power law with a high energy cutoff, but below approx. 4 keV there is a soft excess, suggesting a cold adsorption column modified by partial covering. The observed spectral variations appear to be due to changes in both the shape of the continuum and the adsorption column. The X ray properties of 3A1954+319 indicate that it is a supergiant binary system and the lack of an optical counterpart means that this classification is somewhat tentative. ESA

N90-25831# Sternberg Astronomical Inst., Moscow (USSR).
OPTICAL LIGHT CURVES OF HZ HER IN THE MODEL OF FREELY PRECESSING NEUTRON STAR
I. B. Voloshina and V. M. Lyutyi *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 665-669 (For primary document see N90-25711 19-89)
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Optical light curves to be observed from HZ Herculis are simulated numerically. THe model of freely precessing neutron star in Her X-1 is applied. The comparison with extended B-photometrical data covering a 16 year interval is performed. The best fit parameters of the model are presented. ESA

N90-25832# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
IUE OBSERVATIONS OF CYG X-2 AND SCO X-1: ACCRETION DISKS AND THE Z-SHAPED CURVE
S. D. Vrtilek, W. Penninx, J. C. Raymond, and Frank Verbunt (Amsterdam Univ., Netherlands) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 671-675 (For primary document see N90-25711 19-89)
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The IUE results obtained during two multiwave-length campaigns are presented. Simultaneous observations taken with the Japanese X ray satellite Ginga and numerous ground based radio and optical facilities are included. Cyg X-2 and Sco X-1 are low mass X ray binaries. The simultaneous UV/X ray observations show that there is a direct relationship between the strengths of the UV continuum and line fluxes and the placement of the X ray spectrum in one of the spectral branches. The strengths increase monotonically along the Z with the least UV emission in the horizontal branch and the most in the flaring branch. Models predicting UV continuum emission from the X ray heated surface of the companion star and an X ray illuminated accretion disk were developed. The data/model comparison suggests that X ray heating of the accretion disk is the dominant source of UV emission and that the mass accretion rate increases monotonically along the Z. ESA

N90-25833# Amsterdam Univ. (Netherlands). Astronomical Inst.
ACCRETION INDUCED COLLAPSE AND FIELD DECAY
Ralph Wijers, Hugo Burm, and Frank Verbunt (Astronomical Inst., Utrecht, Netherlands) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 677-681 (For primary document see N90-25711 19-89)
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The suggestion that neutron stars can be formed via accretion-induced collapse of a white dwarf is considered. It is shown that this suggestion is not viable for 4U1626-67 and Her X-1. This leads to the suggestion that some neutron stars may grow old without losing their strong magnetic fields. It implies that there is no observational evidence for the occurrence of accretion-induced collapse in any of the systems for which this process was hitherto suggested. ESA

N90-25834*# Universities Space Research Association, Columbia, MD.
RADIATIVE SHOCK OSCILLATIONS IN AM HER CATACLYSMIC BINARIES
M. T. Wolff, J. H. Gardner, J. N. Imamura, and K. S. Wood (Naval Research Lab., Washington, DC.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 683-688 Sponsored by NASA, Washington; ONR; and NSF (For primary document see N90-25711 19-89)
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The stability properties of radiative shocks in spherically symmetric accretion flows onto white dwarfs is discussed. Accretion rates that result in shock thicknesses ranging from thin to settling solutions are investigated. Models for white dwarf masses from 0.3 to 1.2 of the solar mass are presented. The effects of unequal ion and electron temperatures, electron thermal conduction, bremsstrahlung, and Compton cooling are included. It is shown that thick two-temperature shocks are unstable to oscillations in the fundamental mode for white dwarf mass up to and including 1.0 of the solar mass. The possibility that ths 0.3 to 1.0 Hz optical Quasi-Periodic Oscillations (QPOs) observed in four AM Her type cataclysmic binaries are due to the first overtone instability. Low accretion rate shock instabilities may be responsible for the tens of seconds to several minute X-ray QPOs observed in some AM Her objects. ESA

N90-25835# Hulburt (E. O.) Center for Space Research, Washington, DC.
A MULTI-WAVELENGTH CAMPAIGN TO OBSERVE SCORPIUS X-1: PRELIMINARY RESULTS FROM THE X RAY DATA
K. S. Wood, P. Hertz, J. P. Norris, B. A. Vaughan, P. F. Michelson, Kazuhisa Mitsuda, and T. Dotani (Tokyo Univ., Japan) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 689-692 (For primary document see N90-25711 19-89)
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Between 10 to 12 Mar. 1989, a multi-wavelength campaign to observe Sco X-1 was conducted in the X ray, ultraviolet, optical, and radio bands. The early results from the Ginga X ray data are radio bands. The source was observed on both the flaring and normal branches; a 15 Hz Quasi-Periodic Oscillation (QPO) was observed when Sco X-1 returned to the flaring branch. No optical oscillations were observed during observations simultaneous with X ray QPO data. A possible correlation between low frequency noise shape and position on the flaring branch is noted. ESA

N90-25836# Space Research Organization Netherlands, Utrecht.
TTM-KVANT OBSERVATIONS OF THE GALACTIC PLANE
J. J. M. intZand, T. G. Patterson, A. C. Brinkman, J. Heise, R. Jager, G. K. Skinner, A. P. Willmore, O. Al-Emam, Rashid A. Sunyaev, and E. Churazov (Academy of Sciences, USSR, Moscow) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 693-695 (For primary document see N90-25711 19-89)
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A preliminary analysis of observations obtained on the galactic plane with the TTM X ray widefield camera (coded mask imaging spectrometer) in Kvant relealed in addition to 29 known sources the probable existence of four unknown sources, KS1731-261, KS1724-356, KS1632-477 and KS1739-304. The accuracy of the position of two known X ray sources could be improved: 4U1708-40 and GS1826-24. ESA

N90-25837# Academia Sinica, Nanjing (China). Purple Mountain Observatory.
EXOSAT MEDIUM ENERGY OBSERVATIONS OF BINARY X RAY PULSAR 4U1538-52
Zhi-Yun Zhang and Heng-Rong Hang *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 697-699 (For primary document see N90-25711 19-89)
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The binary X ray pulsar 4U1538-52 was observed from EXOSAT in 1984. The data on 17 Mar. and 10 Aug. is analyzed and discussed. The pulsation periods, 529.9 s and 530.1 s respectively, are longer than that measured in 1983. The instantaneous period rate is about 15 times larger then average spin down rate. The

results suggest that 4U1538-52 is a wind-fed pulsar, and its pulsation period changes in random walk manner in response to fluctuations in the external torque, similar to the case of Vela X-1. ESA

N90-25838# International School for Advanced Studies, Trieste (Italy).
CONSTRAINTS ON THE SS433 SYSTEM FROM THE GINGA OBSERVATIONS
Tomaz Zwitter (Ljubljana Univ., Yugoslavia) and Massimo Calvani *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 701-703 (For primary document see N90-25711 19-89)
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Recent X ray observations with the Ginga satellite of the X ray eclipse in the binary system SS433 are examined. They confirmed and implemented the previous observations with the EXOSAT satellite. The assumptions that allow proceeding from observed data to estimates of the mass of the compact object and the size of the jets are investigated. The results are used to constrain the mass of the compact object in order to clarify its nature. The question concerning the mechanism for the possible transition from a quiescent to an active X ray phase of the system and the connection of exact timing of the X ray eclipses with the sense of the orbital motion are investigated. ESA

N90-25839# European Space Agency, Paris (France).
A LONG LOOK BACK: ESA'S FAINT OBJECT CAMERA. THE STORY OF THE FAINT OBJECT CAMERA, ONE OF ESA'S CONTRIBUTIONS TO THE HUBBLE SPACE TELESCOPE
Norman Longdon, ed. Feb. 1990 22 p Original contains color illustrations
(ESA-BR-67; ISBN-92-9092-047-5; ISSN-0250-1589; ETN-90-96982) Avail: NTIS HC A03/MF A01

The faint object camera is shown in photographic and diagrammatic form. Explanations of how the faint object camera works are illustrated with diagrams and data flow block diagrams. A transfer optics block diagram is presented. The camera entrance aperture projected onto the sky is shown in diagrammatic form. The physical layout of the high resolution apodizer is shown. The industrial organization and responsibilities in the faint object camera project are shown in a tree diagram. The industrial organization and responsibilities in the photon detector assembly project are listed. ESA

N90-25840# Royal Observatory, Edinburgh (Scotland).
RESEARCH AND FACILITIES HANDBOOK 1989
1989 144 p Original contains color illustrations
(ISSN-0267-6281; ETN-90-97072) Avail: NTIS HC A07/MF A01

Aims are to provide a readable, nontechnical description of research carried out, to provide scientists with a concise up-to-date description of national facilities and to provide a comprehensive list of publications by members for 1987 and 1988. Research included cosmology, stars, star formation, and Halley's comet. The facilities described include the United Kingdom Infrared Telescope and Schmidt unit Telescope, the James Clerk Maxwell Telescope, and COSMOS (Coordinates, Sizes, Magnitudes, Orientations, Shapes), a high speed, fully automatic, photographic-plate scanning machine. ESA

N90-25841# European Space Agency, Paris (France).
THE 23RD ESLAB SYMPOSIUM ON TWO TOPICS IN X RAY ASTRONOMY. VOLUME 2: AGN AND THE X RAY BACKGROUND
James J. Hunt, ed. and Bruce T. Battrick, ed. Nov. 1989 407 p Symposium held in Bologna, Italy, 13-20 Sep. 1989
(ESA-SP-296-Vol-2; ISBN-92-9092-026-2; ISSN-0379-6566; ETN-90-96975) Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The contributions to the 23rd ESLAB Symposium concerning Active Galactic Nuclei (AGN) and X-ray background are presented. The following topics are examined: theories of the X-ray background, X-ray spectra of active galactic nuclei (AGN), accretion disks active star forming galaxies, luminosity function, observations of Seyfert galaxies and BL Lacertae objects, spectral luminosity and variability, pair production, iron emission lines, relativistic jets in AGN, quasars, galactic radiation, radio sources, X-ray spectroscopy and galactic clusters. Observations performed by EXOSAT, Mir Space Station equipment, Ginga, and the Einstein Observatory are also included. For individual titles, see N90-25842 through N90-25914.

N90-25842*# Hawaii Univ., Honolulu. Inst. for Astronomy.
THEORIES OF THE X RAY BACKGROUND **c93**
Lennox L. Cowie *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 707-712 (For primary document see N90-25841 19-89)
(Grant NAGw-959)
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Theories of the X-ray background are analyzed. Starburst and probably hard X-ray binary models can be dismissed on the basis of exorbitant energy requirements while the hot diffuse intergalactic medium fails to reproduce the residual spectrum. Active Galactic Nuclei (AGN) models are only viable if there is a class of AGN which puts out the bulk of its energy in the hard X-rays. ESA

N90-25843# Mullard Space Science Lab., Dorking (England).
THE OPTICAL CHARACTERISTICS OF A SAMPLE OF SOFT X RAY SELECTED ACTIVE GALACTIC NUCLEI
G. Branduardi-Raymont, J. P. D. Mittaz, Keith O. Mason, E. M. Puchnarewicz, P. G. Murdin, J. R. Allington-Smith, P. Giommi, G. Tagliaferri, and Lorella Angelini (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 713-717 Sponsored by Royal Society and Science Research Council, England (For primary document see N90-25841 19-89)
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The optical characteristics of a sample of 30 active galactic nuclei (AGN), discovered in EXOSAT CMA fields at high galactic latitude, are discussed. Optical spectra were obtained in the course of the identification work in 1988 and 1989. The data was reduced in a uniform fashion and fitted with multicomponent model spectra. Particular care was used in identifying and modeling the variety of Fe multiplets present in the wavelength band under consideration. Preliminary results of this work in terms of redshift and luminosity distributions, soft X-ray to optical luminosity ratio, and line strengths versus soft X-ray luminosity are discussed. ESA

N90-25844*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
POPULATION PROPERTIES OF AGN IN THE SOFT X-RAY BAND **c93**
D. M. Worrall *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 719-726 Sponsored in part by Smithsonian Research Opportunities Fund (For primary document see N90-25841 19-89)
(Contract NAS8-30751)
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Maximum likehood analysis can be used to separate the intrinsic dispersion of spectral index from the measuring errors for X-ray observed samples of active galactic nuclei (AGN). A finite sigma tends to introduce selection biases, compels the use of large samples in searches for intrinsic properties, and can mask quite substantial trends in X-ray spectral index with other source

properties. The property which appears to affect the mean spectral index is the relative strength of radio emission. The connection between radio and X-ray luminosity is discussed. Observed trends to flatter AGN X-ray spectral components with higher energy may be important in evaluating the composite spectrum of AGN contributing to the cosmic X-ray background. ESA

N90-25845# Leicester Univ. (England). Dept. of Physics.
SPATIAL FLUCTUATIONS IN THE DIFFUSE X RAY BACKGROUND **c93**
R. S. Warwick and G. C. Stewart *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 727-731 (For primary document see N90-25841 19-89)
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Recent measurements of spatial fluctuations in the diffuse X-ray background are shown to constrain the extragalactic log N-log S relation in the 2 to 10 keV energy band to a form close to the Euclidean prediction over the flux range 10(exp -10) to 5 x 10(exp -13) erg/sq cm/s. The normalization of the 2 to 10 keV source counts is a factor approximately 3 above that derived from the Einstein medium sensitivity survey if a spectral conversion is assumed which ignores absorption effects. Both this result and the spectral characteristics of the spatial fluctuations suggest that low luminosity active galaxies dominate the 2 to 10 keV source counts at intermediate flux levels. ESA

N90-25846# Universidad de Santander (Spain). Dept. de Fisica Moderna.
EINSTEIN IPC OBSERVATIONS OF THE 1 TO 3 keV X RAY BACKGROUND **c93**
X. Barcons and A. C. Fabian (Cambridge Univ., England) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 733-735 (For primary document see N90-25841 19-89)
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The approximate arcmin angular distribution of the 1 to 3 keV X-ray background was studied with the use of Einstein Observatory Imaging Proportional Counter (IPC) data. The angular auto-correlation function on scales of approximately 5 arcmin is seen not to exceed 9 percent. Fits to the observed distribution of the fluctuations are performed. They reveal that a Euclidean source population cannot be extrapolated below the flux level where these sources produce approximately 40 percent of the 1 to 3 keV X-ray background. ESA

N90-25847# Osservatorio Astronomico, Padova (Italy).
CONTRIBUTIONS OF DISCRETE SOURCES TO THE X RAY BACKGROUND **c93**
G. DeZotti, L. Danese, A. Franceschini, M. Persic, and L. Toffolatti (Padua Univ., Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 737-742 Sponsored by Italian Ministry of Public Education; Italian Space Agency; CNR; and Harvard-Smithsonian Center for Astrophysics, Cambridge, MA (For primary document see N90-25841 19-89)
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A new analysis of the HEAO 1 A2 data base yielded strong constraints on the local luminosity function of extragalactic X-ray sources. Sources associated with galaxies cannot make up the entire X-Ray Background (XRB) without evolution. The available information on X-ray properties of actively star forming galaxies suggests a contribution at 2 keV lower than 10 percent; a contribution equal or greater than 30 percent implies that these objects comprise an uncomfortably large fraction of medium sensitivity survey and deep survey sources. General constraints on models, assuming that the XRB energy budget comes from nuclear reactions in stars or from accretion into massive black holes, are discussed. ESA

N90-25848*# Space Telescope Science Inst., Baltimore, MD.
ACTIVE STAR-FORMING GALAXIES IN THE X RAY FOREGROUND **c93**
R. E. Griffiths and P. Padovani *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 743-748 (For primary document see N90-25841 19-89)
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Star forming galaxies were discovered as a component of the X-ray background (XRB) in the Einstein deep surveys. Such star forming galaxies may be largely powered by superluminous Population 1 massive X-ray binaries (MXRB), formed in the wake of star formation in regions of low metallicity. The star forming galaxies with moderate numbers of MXRB may evolve into the infrared starburst galaxies found at low redshifts using IRAS (Infrared Astronomy Satellite), and may also be related to those galaxies identified with sub-mJy radio sources. A conservative contribution to the XRB of at least approximately 15 percent, without evolution is estimated. It is shown that moderate evolution leads to a contribution at least equalling that of quasars. Above 3 keV, star forming galaxies may dominate the XRB. ESA

N90-25849*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
BL LACS FROM THE EMSS: NUMBER-COUNTS AND IMPLICATIONS FOR THE LUMINOSITY FUNCTION
Anna Wolter, Isabella M. Gioia, Tommaso Maccacaro, Rudy E. Schild, Simon L. Morris, and John T. Stocke (Colorado Univ., Boulder.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 749-752 Sponsored in part by Smithsonian Institution Scholarly Studies Program (For primary document see N90-25841 19-89)
(Contract NAS8-30751)
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BL Lac objects, extracted from the Einstein Extended Medium Sensitivity Survey (EMSS), are examined. X-ray selection proved to be a powerful tool to find new BL Lacs, and allows the creation of complete, well defined and sizable samples. X-ray selected BL Lac objects (XBL) have in general more starlight in the optical spectra than radio selected BL Lacs. Redshifts for a significant fraction of objects in samples of XBL can be determined. It is thus possible to study the cosmological properties of BL Lac objects. Different models of luminosity functions of BL Lacs, including relativistic beaming, are considered and integrated over luminosity and redshift. The results are compared with the observed number-counts. The observed redshift distribution and the models' predictions are analyzed. ESA

N90-25850# Leicester Univ. (England). X Ray Astronomy Group.
THE X RAY SPECTRA OF EMISSION LINE AGN **c93**
K. A. Pounds *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 753-762 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

Evidence accumulated over the past 3 to 4 years for a soft excess in the X-ray spectra of many active galactic nuclei (AGN) are discussed. They are interpreted as thermal emission from the innermost stable region of an accretion disc feeding the putative black hole at the center of the active nucleus. X-ray data from the EXOSAT and Ginga satellites revealed a second indicator of optically thick matter in the vicinity of the active nucleus, in the form of an iron K-fluorescence line at approximately 6.4 keV. The discovery of two features, of continuum absorption and reflection, are reported. They were revealed in a composite spectrum from multiple Ginga observations of Seyfert-type AGN. The spectral features are modeled by reprocessing of the hard X-ray power

law continuum in a slab (disc) of cold matter. Evidence for a substantial line-of-sight column of photoionized material is found in some AGN. The implications of these X-ray spectral data for a unified model of AGN are discussed. ESA

N90-25851# Nagoya Univ. (Japan). Dept. of Astrophysics.
VERY LOW LUMINOSITY AGN
Katsuji Koyama *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 763-767 (For primary document see N90-25841 19-89)
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Topics of the Ginga observations are presented. The discovery of diffuse thin thermal emission near the galactic center with the iron 6.7 keV line is discussed. The total energy of the plasma is estimated to be about 10(exp 54) erg/s. The scattered and highly absorbed X-ray spectrum from Seyfert 2 galaxies are examined. The discoveries provide a possible link between the Seyfert 2 and Seyfert 1 galaxies. The X-ray emission from a mini-AGN (active galactic nuclei) in the early type galaxy is discussed. ESA

N90-25852# Leicester Univ. (England). X Ray Astronomy Group.
THE SPECTRA (2 TO 10 keV) OF HIGH LUMINOSITY QUASARS
M. J. L. Turner, O. Rees Williams, R. Saxton, G. C. Stewart, Thierry J.-L. Courvoisier, T. Ohashi, K. Makishima, T. Kii, and H. Inoue (Tokyo Univ., Japan) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 769-776 (For primary document see N90-25841 19-89)
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The Ginga 2 to 10 keV spectral survey of quasars produced spectra for eight objects. The mean spectral index of the ensemble is identical with that of lower luminosity active galactic nuclei (AGN). Two quasars, 3C273 and PG1416-129, have 2 to 10 keV spectra harder than the mean. The two brightest quasars in the ensemble, 3C273 (radio-loud) and E1821+643 (radio-quiet) are studied. The spectral index of 3C273 is variable in time, but is not correlated with flux. Both objects show clear evidence for iron emission lines; the equivalent widths, and lack of absorption, are inconsistent with fluorescence in cold, solar abundance material in the line-of-sight. The presence, in both quasars, of a variable soft X-ray excess, also suggests that an accretion disk may be present. ESA

N90-25853# Johns Hopkins Univ., Baltimore, MD.
THE ENVIRONMENTAL IMPACT OF THE X RAY FLUX FROM ACTIVE GALACTIC NUCLEI **c93**
Julian H. Krolik *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 777-781 (For primary document see N90-25841 19-89)
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The X-rays emitted by active nuclei influence the interstellar media of their host galaxies. These effects can be used to indicate properties of the active nucleus not directly observable, and may play a part in regulating the appearance or degree of activity of the nucleus. The various modes of interaction, with emphasis on the use of X-ray observations, are reviewed. ESA

N90-25854# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
GINGA OBSERVATIONS OF THE X RAY SPECTRA OF AGN
H. Inoue *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 783-787 (For primary document see N90-25841 19-89)
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Ginga obtained X-ray spectra in the 1.5 to 37 keV range from several tens of Active Galactic Nuclei (AGNs). The mean spectral slope of those AGNs is steeper than that of the cosmic X-ray background. Seyfert galaxies and possibly radio-quiet quasars generally exhibit iron emission lines with equivalent widths of 100 to 200 eV. Such a large equivalent width of the fluorescent line, together with a shallow and broad absorption feature above the iron K-edge energy, can be interpreted by considering an optically thick accretion disk as a reprocessor of X-rays from a central source. ESA

N90-25855*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE COMPLEX X RAY SPECTRA OF AGN
C. M. Urry, Keith Arnaud, R. A. Edelson, J. S. Kruper (Massachusetts Inst. of Tech., Cambridge.), and R. F. Mushotzky *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 789-795 (For primary document see N90-25841 19-89)
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X-ray spectral surveys of large samples of Seyfert galaxies are discussed. The spectral shape in the 0.1 to 20 keV energy range is considered. Two new spectral survey are undertaken, one involving 105 Imaging Proportional Counter (IPC) observations of 75 Seyfert galaxies, the other using IPC and Monitor Proportional Counter (MPC) data from 28 observations of 23 Seyfert galaxies. The X-ray spectra of active galactic nuclei (AGN) are complex, with in most cases considerable steepening at the lowest energies. At higher energies (2 to 20 keV), the existence of a universal, canonical power law is confirmed, independent of X-ray luminosity over four orders of magnitude. ESA

N90-25856*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
IS AGN SPECTRAL EVOLUTION NEEDED FOR THE CXB
Elihu Boldt *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 797-801 (For primary document see N90-25841 19-89)
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The principal sources of the cosmic X-ray background (CXB) can be objects indicative of a physically early stage of active galactic nuclei (AGN) evolution. Such an evolutionary scenario is examined by using the HEAO-1 A2 X-ray selected sample of bright AGN as a diagnostic of anisotropies in the unresolved background. The observed limit on CXB global anisotropy is used to place an upper bound on the present-epoch volume emissivity of unresolved X-ray sources. Considering the A2 AGN count, CXB surface brightness fluctuations observed at higher energies (via HEAO-1 A4) suggest that present-epoch AGN could have the broadband spectral structure needed for the redshifted contributions of more luminous AGN with this same spectrum to account for the entire CXB. ESA

N90-25857# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
MULTIFREQUENCY OBSERVATION OF BLAZARS
F. Makino *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 803-809 (For primary document see N90-25841 19-89)
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Four blazars, 3C279, BL Lac, Mkn 421 and OJ 278 were observed in the frequency range from radio through X-ray. The X-ray spectra of 3C279 and BL Lac were flatter than those in the IR through UV. The X-ray intensity of 3C279 varied with the IR to UV radiation. These facts strongly suggest SSC (Synchrotron Self-Compton) model. The X-ray spectra of Mkn 421 and OJ 287

were smoothly connected in the wavelength regions from IR through X-rays. The multifrequency spectra can be reproduced qualitatively by a jet model. ESA

N90-25858# European Southern Observatory, Garching (Germany, F.R.).
AGNS AND THE SPECTRUM OF THE X RAY BACKGROUND **c93**
G. Setti (Bologna Univ., Italy) and L. Woltjer *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 811-812 (For primary document see N90-25841 19-89)
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Theories of active galactic nuclei (AGN) predict the existence of numerous AGN with low energy X-ray cutoff in the 10 keV range. The main problem for models in which most of the X-ray background is due to AGNs is the incompatibility of the spectral properties. The resulting spectrum of the X-ray background produced by all AGN may reproduce the observed spectrum. The main obstacle against theories in which most of the X-ray background is due to AGN is removed. ESA

N90-25859# Cambridge Univ. (England). Inst. of Astronomy.
REACCELERATION OF PAIRS IN COMPACT SOURCES **c93**
G. Ghisellini, C. Done, and A. C. Fabian *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 813-817 (For primary document see N90-25841 19-89)
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Models of compact sources in which cold particles are continuously reaccelerated at relativistic energies are investigated. These models yield the break at few MeV that is required to explain the slope of the gamma-ray background. At X-ray energies the predicted spectra are flatter than that observed for a typical active galactic nuclei (AGN). The problem of the accumulation of cold particles inside a compact source is examined and it is concluded that reacceleration is not an adequate solution. ESA

N90-25860# Institute of Physical and Chemical Research, Saitama (Japan).
COMPLEX X RAY SPECTRA AND THICK MATTER IN SEYFERT 1 GALAXIES **c93**
L. Piro (Consiglio Nazionale delle Ricerche, Frascati, Italy), Masaru Matsuoka, and M. Yamauchi *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 819-823 (For primary document see N90-25841 19-89)
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The observations with Ginga of three bright Seyfert 1 galaxies, MCG-6-30-15, NGC 7469 and IC4329A, revealed the existence of a new hard X-ray component above 8 keV. This component is probably produced by absorption and Compton scattering processes of the central continuum on to very thick cold matter surrounding the central source. Detection of iron fluorescence emission lines between 100 and 200 eV and energy of 6.4 keV in all these objects supports this interpretation. ESA

N90-25861# Milan Univ. (Italy). Dipartimento di Fisica.
VARIABILITY IN BL LAC OBJECTS: A SCHEMATIC MODEL
L. Maraschi, A. Celotti, and A. Treves *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 825-829 (For primary document see N90-25841 19-89)
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The systematic variability properties of BL Lac objects at ultraviolet and X-ray frequencies are considered. A theoretical model, based on the propagation of a perturbation along a relativistic jet can account for the observed spectral hardening with increasing intensity in the X-ray band. The observed variability amplitude is predicted to depend on the angle of view. ESA

N90-25862# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). EXOSAT Observatory.
RAPID X RAY VARIABILITY IN BL LACERTAE OBJECTS **c93**
P. Barr, P. Giommi, A. M. T. Pollock, B. Garilli, and D. Maccagni (Consiglio Nazionale delle Ricerche, Milan, Italy) *In its* The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 831-835 (For primary document see N90-25841 19-89)
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A study of the short timescale X-ray variability of BL Lacertae objects is performed using the EXOSAT archive. Two hundred and one observations of 36 BL Lacertae objects revealed rapid variability in 21 observations of eight objects. Evidence for relativistic bulk motions is found in only one source PKS2155-304; 1E1402.3+0416 is also a candidate, its redshift being unknown. The other variable BL Lac objects exhibited less variations. Pronounced spectral changes were found, with the sources being harder when the intensity is higher. ESA

N90-25863# Tokyo Univ. (Japan). Dept. of Physics.
X RAY SPECTRA OF OVV QSOS
T. Ohashi, T. Kii, F. Makino, K. Hayashida, H. Inoue, Katsuji Koyama, K. Makishima, M. J. L. Turner, and O. Rees Williams (Leicester Univ., England) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 837-842 (For primary document see N90-25841 19-89)
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Results on X-ray observations of OVV QSOs with Ginga are reported. Nine objects with redshift ranging from 0.21 to 1.40 were observed. X-ray spectra in 2 to 20 keV were obtained from eight of them. Seven OVVs showed power law photon indices between 1.4 and 2.0. One object (3CR454.3) had a steeper index around 2.7. No clear correlation was seen between the spectral slope and the redshift or luminosity. None of the OVVs showed significant iron emission lines. These spectral features together with the extremely short time variation detected from 3C279 in its outburst suggest that the continuum X-ray emission of OVVs is beamed toward us. ESA

N90-25864# Pennsylvania State Univ., University Park.
ULTRASOFT COMPONENTS IN X RAY-SELECTED AGN
France A. Cordova and John F. Kartje (Chicago Univ., IL.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 843-846 (For primary document see N90-25841 19-89)
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A survey of the ultrasoft X-ray sources in the data base of the Einstein Observatory's imaging proportional counter revealed a large number of active galactic nuclei (AGN) that have ultrasoft X-ray components. The survey contains the highest redshift objects for which soft components are known. Findings on the ultrasoft AGN are summarized. The selection criteria and spectral parameters for the AGN are described. Some of the implications of the high-redshift sources for possible emission mechanisms and luminosity-enhancing processes are considered. ESA

N90-25865*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
THE EINSTEIN ALL-SKY IPC SLEW SURVEY
Martin Elvis, David Plummer, and G. Fabbiano *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 847-851 (For primary document see N90-25841 19-89)
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The construction of the Einstein All-Sky Imaging Proportional Counter (IPC) slew survey is considered. It contains approximately 1000 sources between 10(exp -12) and 10(exp -10) erg/sq cm/s with a concentration toward the ecliptic poles and away from the galactic plane. Several sizable samples of bright soft X-ray selected objects for follow-up ROSAT and ASTRO-D observations and statistical study are presented. The survey source list is expected to be available by late 1989. Both paper and remote access online data base versions are to be available. An identification program is considered. ESA

N90-25866# California Inst. of Tech., Pasadena.
PROPERTIES OF SOURCES THAT MAY CONTRIBUTE THE OTHER HALF OF THE COSMIC X RAY BACKGROUND c93
Maarten Schmidt *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 853-855 (For primary document see N90-25841 19-89)
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Known types of extragalactic X-ray sources contribute about half of the cosmic X-ray background at 2 keV. The properties of the discrete sources that may provide the other half of the background are discussed. If these sources are Active Galactic Nuclei (AGNs) that evolve in space density and in spectrum or if the sources are a new unknown class they may be detected by ROSAT. If they are much rarer, then even AXAF (Advanced X-ray Astrophysics Facility) may not be able to detect such a potential contributor to the background. ESA

N90-25867*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SIGNPOSTS TO THE FUTURE
R. F. Mushotzky *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 857-861 (For primary document see N90-25841 19-89)
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The major scientific issues raised in this meeting about Active Galactic Nuclei (AGN) are summarized. The X-ray background and the capabilities of missions to be launched in the next 5 years (GRANAT, ROSAT, BBXRT, GRO, Astro-D, SAX, Spectrum-X-gamma, XTE) are discussed. Each one of these missions is considerably more powerful than its predecessor and will add to the knowledge of AGN and the X-ray background. By the end of the 1990's both of the X-ray astronomy Great Observatories, Advanced X-ray Astrophysics Facility (AXAF) and X-ray Multi mirror Mission (XMM), should be flying, each one of them more powerful than the intermediate scale missions of the early 1990's. ESA

N90-25868# Oxford Univ. (England). Dept. of Astrophysics.
LONG TIMESCALE X RAY VARIABILITY IN AGN
Roberto G. Abraham and Ian M. McHardy *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 865-870 Sponsored by Science Research Council, England (For primary document see N90-25841 19-89)
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Long timescale medium energy light curves are constructed for a number of Active Galactic Nuclei (AGN), using data primarily from EXOSAT, Einstein, HEAO-1, and Ariel 5. Power spectra for these light curves were compared to the spectra of identically sampled simulated light curves with known spectral properties. It is concluded that reliable results can be obtained for some of the brighter AGN. Results for NGC 4151 are presented. This power spectrum is combined with a short timescale EXOSAT power spectrum to search for a characteristic timescale at low frequencies. It is found that the power spectrum of NGC 4151 is similar to 1/f noise on long timescales, but the sharp turnover seen in Cygnus X-1 is not observed. ESA

N90-25869# International School for Advanced Studies, Trieste (Italy).
X RAY AGN VARIABILITY WITH HOUR TO MONTH TIMESCALES
M. A. Abramowicz, G. Bao, A. Lanza, and X.-H. Zhang (International Centre for Theoretical Physics, Trieste, Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 871-876 (For primary document see N90-25841 19-89)
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Periodic flares and dips in the Active Galactic Nuclei (AGN) X-ray light curves are explained by bright spots on an accretion disk surface. For a disk seen almost edge-on the spots are eclipsed or Doppler beamed and this occasionally produces short sequences of repeated dips or flares. Spots located in a narrow range of radii, produce distinct peaks in the variability power spectra. When the range is broad, a power spectrum is produced with beta = 7/3 for spots with long lifetimes on a Keplerian disk. Short lifetimes and non-Keplerian rotation are consistent with beta between 1 and 2. ESA

N90-25870# International School for Advanced Studies, Trieste (Italy).
EXTENDED LINE EMISSION IN AGN: LOOKING AT THE CENTRAL ENGINE
J. AcostaPulido, I. Perez-Fournon, Massimo Calvani, and A. S. Wilson (Maryland Univ., College Park.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 877-881 (For primary document see N90-25841 19-89)
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The regions of high excitation gas detected around various Active Galactic Nuclei (AGN) are examined. The radiation emitted by the nucleus may be responsible for the high ionization of the line emitting gas. Evidence that the radiation field is anisotropic and collimated in a direction close to the cone axis is found. The possibility that a geometrically thick accretion disk is the source of the ionizing continuum is considered. Theoretical predictions and observational data are compared. The energetics requirements and the spatial distribution of the extended emitting gas for Seyfert and radio galaxies are analyzed. ESA

N90-25871# Hamburger Sternwarte G.m.b.H. (Germany, F.R.).
FAST CLASSIFICATION OF ROSAT SOURCES ON OBJECTIVE PRISM PLATES
N. Bade, H.-J. Hagen, and D. Reimers *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 883-884 (For primary document see N90-25841 19-89)
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Newly discovered X-ray sources from the ROSAT all-sky survey are classified. Digitized spectra from objective prism plates are applied. A crude classification of a great number of X-ray sources is provided. An online classification to observe new peculiar objects afterwards in the pointed observing mode is described. ESA

N90-25872*# California Univ., Berkeley. Dept. of Astronomy.
DETAILED NON-LTE CALCULATIONS OF THE IRON EMISSION FROM NGC 1068
David L. Band, Richard I. Klein, John I. Castor, and J. K. Nash (Lawrence Livermore National Lab., CA.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 885-889 Sponsored by NASA, Washington (For primary document see N90-25841 19-89)
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The X-ray iron line emission from NGC 1068 observed by the Ginga satellite is modeled using the new multiline, multilevel, non-LTE radiative transport code ALTAIR and a detailed atomic model for Ne-like through stripped iron. The parameter space of the obscured type 1 Seyfert nucleus model for this object is studied. The equivalent width is greater than previously predicted. It is found that detailed radiative transfer can have a significant effect on the observed line flux both for the K alpha line and for the L-shell emission. The ionization of the iron increases with temperature. Therefore the K alpha equivalent width and energy is a function not only of the ionization parameter, but also of the column depth and temperature. For a likely model of NGC 1068 it is found that the iron abundance is about twice solar, but that modifications of this model may permit a smaller abundance.

ESA

N90-25873# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.).

QUANTUM EFFECTS IN PAIR CASCADE MODELS OF AGN SPECTRA

Matthew G. Baring *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 891-896 (For primary document see N90-25841 19-89)

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The prediction that electrons with very high Lorentz factors can be produced in the central region of AGN (Active Galactic Nuclei) is considered. The recent steady state Compton pair cascade models of AGN X-ray and gamma-ray emission mechanisms need modification as quantum (Klein-Nishina) effects must be taken into account. These are examined in first order cascades. Their influence on the spectral indices of the hard X-ray and soft gamma-ray emission is assessed. The inclusion of scatterings in the quantum regime provides an increase in the particle population at high energies and flattens the gamma-ray spectra both above and below the pair absorption turnover. Difficulties in the fitting of spectral observations are created.

ESA

N90-25874# Consiglio Nazionale delle Ricerche, Bologna (Italy). Lab. TE.S.R.E.

HARD X RAY OBSERVATIONS OF ACTIVE GALAXIES

L. Bassani, A. Bazzano, A. Court, A. J. Dean, N. Dipper, R. Lewis, P. Maggioli, F. Perotti, E. Quadrini (Consiglio Nazionale delle Ricerche, Milan, Italy), and S. Rebecchi et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 897-899 (For primary document see N90-25841 19-89)

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The spectral data of three active galaxies, observed in the hard X-ray energy band during two balloon flights of the MIFRASO (Milan-Frascati-Southampton) telescope are presented. In the summer of 1986 only the Seyfert galaxy NGC 4151 was observed, while a year later the instrument pointed at the quasar 3C 273, the Seyfert galaxy MCG 8-11-11 and reobserved NGC 4151. The MIFRASO hard X-ray spectra are compared to other high energy measurements of the same objects. It is readily apparent that the emission from each source is variable in time. An analysis of archive data indicates that the power law continuum observed at soft X-ray energies extends with the same slope up to at least 200 keV and that the overall photon spectral index appear to remain substantially constant while the source intensity changes in time.

ESA

N90-25875# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Astrofisica Spaziale.

A HARD X RAY OBSERVATION OF THE COMA CLUSTER

A. Bazzano, A. Court, A. J. Dean, N. Dipper, R. Lewis, P. Maggioli, F. Perotti, E. Quadrini, J. B. Stephen (Consiglio Nazionale delle Ricerche, Bologna, Italy), and P. Ubertini *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 901-903 (For primary document see N90-25841 19-89)

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Preliminary results of a hard X-ray measurement of the Coma Cluster of galaxies are presented. They were obtained with the MIFRASO (Milan-Frascati-Southampton) telescope on 15 Jul. 1987. High energy component was detected between 30 and 130 keV at a level of 4.4 standard deviation with scintillation detectors covering the energy range 20 to 300 keV. The analysis of the data obtained with the proportional counters on board the same experiment is presented.

ESA

N90-25876*# Tuebingen Univ. (Germany, F.R.). Astronomisches Institut.

THE DEPENDENCE OF THE SOFT X RAY SPECTRAL SLOPE WITH RADIO PROPERTY, LUMINOSITY, AND REDSHIFT, FOR A LARGE SAMPLE OF AGN FROM THE EINSTEIN IPC DATA BASE

H. Brunner, D. M. Worrall, Belinda J. Wilkes, and Martin Elvis (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 905-908 Sponsored in part by DFG (For primary document see N90-25841 19-89)

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The dependence of the soft X-ray spectral slope on radio, optical and X-ray properties, and on redshift are reported for a large sample of Active Galactic Nuclei (AGN). The sample includes 317 optically and radio-selected AGN from a preliminary version of the Einstein Imaging Proportional Counter (IPC) quasar and AGN data base. The main results are: the difference in X-ray slope between radio-loud and radio-quiet AGN were confirmed for an independent and much larger sample of sources; a difference in X-ray slope between flat and steep radio spectrum AGN is observed only in high luminosity sub-sample; in flat radio spectrum AGNs there is an indication for a dependence of the X-ray spectral index on X-ray luminosity redshift and alpha sub 0x.

ESA

N90-25877# Princeton Univ. Observatory, NJ.

QSO OPTICAL COUNTS AND CONSTRAINTS ON THE X RAY BACKGROUND

A. Chokshi, E. L. Turner, and J. P. Ostriker *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 909-913 (For primary document see N90-25841 19-89)

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The optical and the X-ray properties of optically selected quasars are used to predict the soft X-ray source counts in the Einstein Imaging Proportional Counter (IPC) band. The optical quasar counts and the published alpha sub 0x relations do not reproduce the observed X-ray source counts. The predicted counts exceed the observations by factors of five to fifty. These excesses arise from the low luminosity, low redshift active galactic nuclei, redshift range characterizing the optical sample. It is concluded that quasars cannot be major contributors to the soft X-ray background.

ESA

N90-25878# European Space Agency. ESA Tracking Station, Madrid (Spain). IUE Observatory.

THE EUV SPECTRAL SHAPE OF THE BIG-BUMP IN HS1700+6416 AND F9: A GENUINE DIFFERENCE BETWEEN SEYFERT'S AND QSO'S

J. Clavel, M. Santos-Lleo, W. Wamsteker, and D. Reimers (Hamburger Sternwarte G.m.b.H., Germany, F.R.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy.

Volume 2: AGN and the X Ray Background Nov. 1989 p 915-919 (For primary document see N90-25841 19-89)
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The recent discovery of the high redshift quasar HS1700+6416 and repeated observations of the Seyfert 1 galaxy Fairall 9 reveal a striking difference between their continuous spectral shape in the Extreme Ultraviolet (EUV). A geometrically thin alpha disk model cannot account for the energetic EUV continuum observed in HS1700+6416. The EUV spectral shape of F9 fits the predictions from the thin accretion disk model. These results suggest the existence of a difference between Seyfert 1 galaxies and quasars, the former having a cooler bump than the latter. ESA

N90-25879# Geneva Observatory (Switzerland).
LONG TERM MULTI-FREQUENCY STUDY OF 3C 273
Thierry J.-L. Courvoisier *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 921-924 (For primary document see N90-25841 19-89)
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The behavior of 3C 273 is investigated. The sampling of the radio, near IR, visible and UV domains allows a cross-correlation analysis of the different components. The main emerging global features are a first link between thermal (UV) and nonthermal (radio) activities, a strong decoupling of the X-ray emission from all other emission components, a close connection between the UV and the optical light curves (excluding the nonthermal flaring activity) and the stability of the quiescent near infrared emission. ESA

N90-25880# Lawrence Livermore National Lab., CA. Dept. of Physics.
ION-HEATED THERMAL COMPTONIZATION MODELS AND X RAY SPECTRAL CORRELATIONS IN ACTIVE GALACTIC NUCLEI
Charles D. Dermer *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 925-929 Previously announced as N90-16667 (For primary document see N90-25841 19-89)
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Recent Ginga observations of the Seyfert 1 galaxies NGC 4051 and MCG 6-30-15 show a positive correlation between the 2 to 10 keV luminosity and photon spectral index alpha. A two-temperature thermal comptonization model with internal soft-photon production provides an explanation for this correlation. The electron temperature, decreases in response to an enhancement of the soft photon flux, resulting in a softening of the spectrum and an increase in the soft X-ray luminosity. The bulk of the soft photons are produced through pion production in collisions between the hot ions. A test of the model would be time correlations between soft and hard X-ray bands. ESA

N90-25881# Heidelberg Univ. (Germany, F.R.). Institut fuer Theoretische Astrophysik.
THE ACCRETION DISK IN THE GALACTIC CENTER: AN INDEPENDENT INDICATION FOR A MASSIVE CENTRAL OBJECT
Wolfgang J. Duschl *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 931-934 (For primary document see N90-25841 19-89)
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Evidence of the existence of a massive compact object in the galactic center is presented. It is based on the distribution of gas in the central few parsecs of our galaxy. The gas ring is described as a viscous accretion disk and its sharp inner edge is used as a diagnostic tool to get information about the underlying mass distribution. The result indicates that there is only a small amount of mass between the ring's inner edge and a central object. ESA

N90-25882# Rome Univ. (Italy). Ist. Astronomico.
THE X RAY TIME VARIABILITY OF NGC 6814 REVISITED
F. Fiore and E. Massaro *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 935-938 (For primary document see N90-25841 19-89)
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The results of an accurate harmonic analysis of five EXOSAT observations of the Seyfert galaxy NGC 6814 carried out over a 2 year period are presented. The detection of the 12,200 s periodic signal with its rich harmonic structure, during the longest (approximately 1 day) observation is confirmed. A strong peak at 0.0004 Hz is found in the composed power spectrum of all the observations, revealing that this phenomenon is characteristic of the X-ray emission from this source at least over 2 years. The power spectrum of the longest observation has a continuous component similar to those observed in other Seyfert galaxies. ESA

N90-25883# Durham Univ. (England). Dept. of Physics.
PURE LUMINOSITY EVOLUTION AND THE AGN CONTRIBUTION TO THE X RAY BACKGROUND
Ioannis Georgantopoulos and Thomas Shanks *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 939-943 (For primary document see N90-25841 19-89)
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Calculations are performed in order to estimate the Active Galactic Nuclei (AGN) contribution to the diffuse X-ray background. It is found that the optical luminosity function of Boyle et al. combined with the relation between L sub x and L sub 0 gives a low AGN contribution to the X-ray background. When evolving the local, X-ray, AGN luminosity function of Schmidt and Green it is found that AGN could account for the whole of the X-ray background. This discrepancy can be attributed to the different slopes of the optical and the X-ray luminosity function. This disagreement of the faint end slopes is probably due to the poor statistics of the X-ray data at low luminosities or less plausibly due to heavily reddened low luminosity AGN. Pure luminosity evolution is shown to be consistent with the X-ray background anisotropy at both the degree and arcminute angular scale. ESA

N90-25884# Cambridge Univ. (England). Inst. of Astronomy.
IRON LINES FROM X RAY ILLUMINATED ACCRETION DISCS IN AGN
I. M. George, A. C. Fabian, K. Nandra, K. A. Pounds, and G. C. Stewart (Leicester Univ., England) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Backgground Nov. 1989 p 945-950 (For primary document see N90-25841 19-89)
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The substantial amounts of optically thick, cold gas able to survive close to the continuum-emitting regions of Active Galactic Nuclei (AGN) can reprocess the nonthermal spectrum. In the X-ray band, iron K-shell features can provide a strong diagnostic of the geometry and kinematics of the innermost regions of the putative accretion flow. A specific geometry of the cold material, namely that of a Keplerian accretion disc surrounding a supermassive object is considered. Results are presented from Monte Carlo simulations of both the fluorescence and continuum emission from a cold, flat, optically thick disc when illuminated by an external nonthermal radiative flux. Model spectra are fitted to Ginga data from NGC 3227. It is found that the form of the X-ray spectrum of this object is consistent with such a scenario. ESA

N90-25885# Space Research Organization Netherlands, Utrecht. Lab. for Space Research.

SIMULATIONS OF HIGH-RESOLUTION X RAY SPECTRA OF AGNS

J. S. Kaastra, R. Mewe, and A. C. Brinkman *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 951-956 (For primary document see N90-25841 19-89)

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The improvements in spectral resolution and sensitivity in soft X-rays detection by NASA's Advanced X-ray Astrophysics Facility (AXAF) and ESA's X-ray Multi-Mirror Mission (XMM) are underlined. Spectral simulations with 0.05A resolution are performed to investigate the diagnostic capabilities of the XMM reflection grating spectrometer for Active Galactic Nuclei (AGN) spectra. Observations of resolved emission lines and absorption edges in soft X-rays allow a better interpretation of the origins of the different spectral components. ESA

N90-25886# Institute of Physical and Chemical Research, Saitama (Japan).

MULTIWAVELENGTH OBSERVATIONS OF BL LACERTAE

Nobuyuki Kawai, Joel N. Bregman (Michigan Univ., Ann Arbor.), and Masaru Matsuoka *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 957-960 (For primary document see N90-25841 19-89)

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Simultaneous multiwavelength observations of BL Lacertae were performed on two occasions separated by one month in June and July 1988. The radio, submillimeter, infrared, optical, ultraviolet, and X-ray wave bands were investigated. The results on the wideband photon spectra, show that the X-ray flux lies above the extension of radio-ultraviolet continuum. The slope of the X-ray spectra is flatter than that at optical-ultraviolet regimes, and its spectral index is between 0.7 and 1.0. Comparison with earlier observations indicates that the X-ray flux is correlated with submillimeter band. ESA

N90-25887*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

A SEARCH FOR IRON FEATURES IN THE EXOSAT SPECTRAL SURVEY SOURCES

K. M. Leighly, K. A. Pounds (Leicester Univ., England), and T. J. Turner *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 961-967 (For primary document see N90-25841 19-89)

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The results of the search for iron features performed on 40 of the 48 EXOSAT spectral survey sources are discussed. In thrirteen of the sources the spectral fit was improved by the inclusion of an iron emission line at approximately 6.5 keV. In three of these, an ionized absorption edge improved the spectral fit. In one source, the spectral fit was improved by the addition of a cold iron absorption edge at approximately 7.1 keV. Line equivalent widths are not well determined. A statistical analysis of the line fits suggest an inverse correlation between line equivalent width and intrinsic source luminosity. Comparison of the host galaxy axial ratio with the line equivalent width suggests that larger equivalent widths occur in sources with more nearly face on host galaxies. ESA

N90-25888*# Montana State Univ., Bozeman.

ELECTRON POSITRON PAIR WINDS AND THE EDDINGTON LIMIT **c90**

K. M. Leighly and S. Tsuruta *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 969-973 Sponsored by NASA, Washington (For primary document see N90-25841 19-89)

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The dynamics of pair winds in the environment of the central engine of Active Galactic Nuclei (AGN) are investigated assuming super Eddington accretion onto black holes. If the accretion is assumed to be spherically symmetric with the accreting matter occurring in discrete cool blobs, and pairs are produced by a nonthermal mechanism, these pairs are blown out by radiation pressure if the coupling between the pairs and accreting blobs is not complete. The coupling also determines the escaping luminosity. If the maximal coupling constraint is relaxed, then a qualitative argument shows that the classical Eddington limit may be exceeded. When the pairs are considered to be noninteracting particles, the outflow is optically thin. Frame dependent effects are considered. Equations are derived considering pair production in the rest frame of the wind and also in the rest frame of the accreting cool blobs. The hydrodynamic equations are integrated numerically. ESA

N90-25889# Tuebingen Univ. (Germany, F.R.). Astronomisches Institut.

HARD X RAY OBSERVATIONS OF AGN

M. Maisack, E. Kendziorra, B. Mony, R. Staubert, S. Doebereiner, J. Englhauser, W. Pietsch, C. Reppin, J. Truemper, and V. V. Efremov (Academy of Sciences, USSR, Moscow) et al *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 975-979 (For primary document see N90-25841 19-89)

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Preliminary spectral results of hard X-ray observations (20 to 200 keV) of Active Galactic Nuclei (AGN) are presented. The observations were performed with the High Energy X-ray Experiment (HEXE) instrument of the Kvant module docked to the Soviet Space Station Mir. Three AGNs were observed: 3C 273, Cen A and NGC 4151. Power law fits to the data gave the following results: for 3C 273, the photon index was 1.49 + or - 0.11, the intensity was (6.93 + or - 0.29) x 0.00001 photons/sq cm sec keV. For Cen A, the best fit photon index was about 1.6 for two observations about a year apart. The intensity increased by a factor of at least 1.7 between the two observations. For NGC 4151, no change in spectral shape was found between November 1987 and January 1989. A common fit gave the photon index of 1.54 + or - 0.11. The intensity can only be determined for the November 87 data. The 50 keV intensity was found to be (5.72 + or - 0.29) x 0.00001 photons/sq cm sec keV. ESA

N90-25890# Milan Univ. (Italy). Dipartimento di Fisica.

THERMAL COMPTONIZATION IN ACCRETION DISKS

L. Maraschi and S. Molendi *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 981-984 (For primary document see N90-25841 19-89)

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The standard model of an accretion disk is considered. The temperature in the inner region is computed. It is assumed that the radiated power derives from comptonized photons, produced in a homogeneous single temperature plasma, supported by radiation pressure. The photon production mechanisms are purely thermal. Three different approximations for the effects of comptonization on the energy loss are used. The maximum temperature is very sensitive to the accretion rate and viscosity parameters. For high viscosity and accretion rate the emission spectra show a flat component following a peak corresponding to the temperature of the innermost optically thick annulus. For 10 to the 8th power of the solar mass the peak is in the ultraviolet and the flat component appears above 1 keV. The model can thus potentially account for the ultraviolet excess as well as for the X-ray spectra observed in active galactic nuclei. ESA

N90-25891# Institute of Physical and Chemical Research, Saitama (Japan).
X RAY SPECTRAL VARIABILITY IN SEYFERT 1 GALAXIES
Masaru Matsuoka, M. Yamauchi, and L. Piro (Consiglio Nazionale delle Ricerche, Frascati, Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 985-989 (For primary document see N90-25841 19-89)
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Ginga observations revealed spectral variations in Seyfert galaxies, NGC4051, NGC5548, NGC7469, MCG-6-30-15, and IC4329A. These variations are described by spectral index changes, correlated with luminosity. A variation delta gamma equal to 0.3 to 0.4 around gamma equal to 1.7 is associated with a change by a factor of 3 to 4 of the intensity. An empirical formula of delta gamma is derived in the 2 to 30 keV band from the analysis of two rapid variable Seyfert galaxies, NGC4051 and MCG-6-30-15. The observed positive correlation between the spectral index and luminosity might originate from the central source near a black hole, providing a strong constraint on radiative models. ESA

N90-25892# Rome Univ. (Italy). Ist. Astronomico.
X RAY POLARIZATION OF THE REPROCESSED EMISSION FROM ACCRETION DISK IN SEYFERT GALAXIES
G. Matt, E. Costa, G. C. Perola, and L. Piro (Consiglio Nazionale delle Ricerche, Frascati, Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 991-993 (For primary document see N90-25841 19-89)
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By means of Monte Carlo simulations, the polarization of the radiation reprocessed by cold matter close to the central emitting region in Active Galactic Nuclei (AGNs) is computed. Disk-like geometry and a high optical depth for the matter is taken into account. The polarization of the reprocessed component alone is roughly energy-independent in the band 2 to 50 keV, and is approximately 20 percent for an edge-on disk. The polarization of the sum of the direct and of reprocessed components has a strong dependence on the energy, and can reach the values of 4 to 5 percent for energies greater than 30 keV. The spectrum is in agreement with Ginga observations of Seyfert galaxies. ESA

N90-25893*# Northwestern Univ., Evanston, IL. Dept. of Physics and Astronomy.
X RAY EMISSION FROM RELATIVISTIC JETS IN AGNS AND STATISTICAL IMPLICATIONS
Fulvio Melia and Arieh Koenigl (Chicago Univ., IL.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 995-1000 Sponsored in part by Sloan (Alfred P.) Foundation; Rockwell International Corp.; and Louis Block Fund (For primary document see N90-25841 19-89)
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Calculations of the Compton scattering interaction between an ultrarelativistic jet and a thermal radiation field, in an Active Galactic Nuclei (AGN), are presented. This process can be effective in decelerating ultrarelativistic jets that are accelerated by electromagnetic or hydromagnetic forces closer in to the central black hole. A narrow distribution of terminal Lorentz factors gamma sub infinity, consistent with the values inferred in superluminal radio sources, arises naturally in this model. The hard X-ray component detected in the spectra of 3C273 and several BL Lac objects may be due to the inverse Compton radiation produced in the course of the initial deceleration of their relativistic jets. The requirement that the luminosity of the hard X-ray component must exceed the total power in the associated jet is considered. ESA

N90-25894# Consiglio Nazionale delle Ricerche, Milan (Italy). Ist. di Fisica Cosmica.
CONSTRAINTS ON THE HIGH ENERGY PROPERTIES OF ACTIVE GALACTIC NUCLEI **c90**
Sandro Mereghetti *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1001-1003 (For primary document see N90-25841 19-89)
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Information on the statistical properties of the high energy emission from Active Galactic Nuclei (AGN's) can be derived assuming that they contribute to the Cosmic Diffuse Background (CDB) in the 200 keV to 20 MeV energy range. Gamma-ray number-flux relations for AGN's are computed. They are based on their X-ray luminosity function, and different assumptions on their spectral shape and cosmological evolution are made. The limit on their integrated emissivity poses some constraints on the possible spectral shape and evolution of AGN's at hard X-ray/gamma-ray energy. The derived constraints are discussed. ESA

N90-25895*# Osservatorio Astronomico, Palermo (Italy).
SPATIAL AND SPECTRAL FEATURES OF SOFT DIFFUSE X RAY BACKGROUND SEEN BY THE EINSTEIN OBSERVATORY
G. Micela, F. R. Harnden, R. Rosner, Jr. (Chicago Univ., IL.), S. Sciortino, and G. S. Vaiana *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1005-1010 Sponsored in part by NASA, Washington; CNR, Italy; Italian Ministry of Public Education; Italian Space Agency; and Smithsonian Institution (For primary document see N90-25841 19-89)
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A survey of the diffuse soft X-ray background as seen directly by the Einstein Observatory Imaging Proportional Counter (IPC) is presented. A source free region of the detector 1 by 1 degree field is used. The background in the 0.16 to 3.5 keV spectral region is viewed. The data covers roughly 5 percent of the sky, with some bias in coverage towards the galactic plane. The moderate energy resolution of the IPC enables the characterization and the production of maps of the background as a function of energy within the Einstein passband. The results are compared with previous observations of the diffuse X-ray background. The implications for galactic structure and for the soft component of the extragalactic X-ray background are discussed. ESA

N90-25896# Institute of Physical and Chemical Research, Saitama (Japan).
EFFECT OF X RAY SPECTRA OF SEYFERT GALAXIES ON THE COSMIC X RAY BACKGROUND **c93**
K. Morisawa, Masaru Matsuoka, F. Takahara, and L. Piro (Consiglio Nazionale delle Ricerche, Frascati, Italy) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1011-1016 (For primary document see N90-25841 19-89)
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Ginga observations of five Seyfert 1 galaxies revealed that their X-ray spectra have an absorption like feature at the energy of several to 10 keV. This feature is probably explained by the absorption of very thick cold matter, covering about half of the central source. It is found that the superposition of such spectra can reproduce the 3 to 100 keV spectrum of the cosmic X-Ray Background (XRB) provided that the spectra of Seyfert galaxies have an exponential cut off around 100 keV. If all Seyfert galaxies and quasars have such spectra and undergo the same cosmological evolution, the observed log N-log S relation of Active Galactic Nuclei (AGNs) and the intensity and fluctuation of the XRB, can be explained. ESA

N90-25897# Illinois Univ., Urbana-Champaign. Dept. of Physics.

SPHERICAL ACCRETION WITH THERMAL PAIR PRODUCTION AS MODELS OF AGN **c90**

Myeong-Gu Park *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1017-1020 (For primary document see N90-25841 19-89)

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New self-consistent solutions of spherical accretion onto black holes with significant pair productions in Active Galactic Nuclei (AGN) are found. The maximum pair density is a few times that of the ionized electrons. Relativistic hydrodynamic equations, radiation moment equations, and pair continuity equations are integrated iteratively. The radiation generated by the matter include the pairs controls, the thermal and dynamical structure of the flow. New solutions have approximately 10 to 100 times higher luminosities than the corresponding solutions with negligible pair productions. ESA

N90-25898# Leicester Univ. (England). X Ray Astronomy Group.

THE X RAY SPECTRUM OF MCG-6-30-15

K. Nandra, K. A. Pounds, G. C. Stewart, I. M. George, and A. C. Fabian (Cambridge Univ., England) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1021-1026 (For primary document see N90-25841 19-89)

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EXOSAT and Ginga observations of the type I Seyfert galaxy MCG-6-30-15 revealed a complex picture of the X-ray spectrum. The soft excess found in the first EXOSAT observation was confirmed in the spectral analysis of the EXOSAT long-look data. Evidence for iron features arising from cold material close to the nucleus is obtained. The iron features were confirmed by the Ginga LAC. The X-ray observations provide good evidence for an accretion disc in MCG-6-30-15 which presents a signature both in the soft band and around 7 keV where measurable iron features are produced. There is also evidence for a possible warm absorber around the central source. ESA

N90-25899# University Coll., London (England). Dept. of Physics and Astronomy.

OPTICAL FeII EMISSION AND THE BLR STRUCTURE IN QSOS

P. T. OBrien and W. Zheng (Alabama Univ., Tuscaloosa.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1027-1031 Sponsored in part by Science Research Council, England (For primary document see N90-25841 19-89)

(Grants NSF RII-86-10669; NATO-88-131)

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The relation that objects with flat soft X-ray spectra have weak optical Fe II emission is not confirmed for a sample of 34 Quasi Stellar Objects (QSOs). Objects with strong optical Fe II emission have narrow H beta lines. This trend is much weaker with Ly alpha. These relations imply that the Fe II and H beta lines arise from gas in a different geometrical arrangement to that emitting Ly alpha, possibly in the form of an accretion disk. Models of the Broad Line Region (BLR) in QSO are considered. ESA

N90-25900*# Space Telescope Science Inst., Baltimore, MD.

X RAY CONSTRAINTS ON THE BEAMING HYPOTHESIS FOR BL LACERTAE OBJECTS

P. Padovani and C. M. Urry *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1033-1036 Sponsored in part by Montedison Fellowship (For primary document see N90-25841 19-89)

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BL Lacertae objects may be Fanaroff-Riley type I (FR I) galaxies with a relativistic jet roughly parallel to the line of sight. The ratio of parent objects (FR Is) to beamed objects (BL Lacs) depends only on the jet velocity. Recently this ratio become observable. X-ray-flux-limited samples are used to demonstrate the viability of the beaming hypothesis. In the process, the X-ray luminosity functions of FR I galaxies and BL Lac objects are derived. Their respective contributions to the cosmic X-ray background radiation are calculated. ESA

N90-25901# Barcelona Univ. (Spain). Dept. de Fisica de l'Atmosfera, Astronomia i Astrofisica.

THE IRON ABUNDANCE GRADIENT IN THE INTRACLUSTER MEDIUM OF PERSEUS: A GALACTIC WIND MODEL. APPLICATION TO OTHER CLUSTERS

J. Pastor, Ramon Canal, and B. Sanahuja *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1037-1042 (For primary document see N90-25841 19-89)

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A radial gradient of the iron abundance was measured in the central part of Perseus cluster. A numerical model for the chemical evolution of the intracluster gas of Perseus is presented. It predicts this gradient, based on metal enrichment of the primordial gas by winds from cluster galaxies. The model is applied to Coma and to other four clusters. The presence or the absence of an iron gradient in their central parts is predicted. No gradient is predicted for Coma. For the other three clusters the models shows that a gradient is likely provided that the quotient of the respective M/L ratios for elliptical and for lenticular galaxies be not exceedingly high. ESA

N90-25902# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.

COMPARING MEASUREMENTS OF AGN X RAY SPECTRA WITH THE SHAPE OF THE DIFFUSE X RAY BACKGROUND SPECTRUM

D. A. Schwartz, Y. Qian, and W. H. Tucker *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1043-1049 (For primary document see N90-25841 19-89)

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Einstein Imaging Proportional Counter (IPC) spectra of quasars are analyzed using alternatives to the canonical power law shape. It is found that either a log-Gaussian or a power law plus thermal bremsstrahlung shape gives fits which are equally good. For 33 quasars previously analyzed a chi-squared test requires the addition of an extra parameter, producing energy dependent curvature to the power law index. The mean values of the parameters found are close to a critical region defined by Schwartz and Tucker. The Einstein spectral measurements provide new, independent evidence that Active Galactic Nuclei (AGN) are the significant source of the X-ray background. ESA

N90-25903# Warsaw Univ. (Poland). Astronomical Center.

VARIABILITY OF THE CONTINUUM EMISSION OF GQ COMAE

Aneta Siemiginowska *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1051-1052 (For primary document see N90-25841 19-89)

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The optical/UV part of the spectrum of GQ Comae (1202+281) is analyzed. It is accepted that the optical/UV/soft X-ray big bump in Active Galactic Nuclei (AGN) spectra is caused by the thermal radiation from an accretion disc. Attributing the observed variability in AGN spectra to the accretion disc instabilities, both the continuum shape and variability of GQ Comae can be explained. Constraints on some model parameters are established. ESA

N90-25904# Tata Inst. of Fundamental Research, Bombay (India).
X RAY SPECTRUM AND VARIABILITY OF MRK 509 AS OBSERVED WITH EXOSAT AND GINGA
K. P. Singh, N. J. Westergaard, H. W. Schnopper, H. Awaki, and Y. Tawara (Nagoya Univ., Japan) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1053-1058 (For primary document see N90-25841 19-89)
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The X-ray light curves and spectra of Mrk 509 are presented. Data from the EXOSAT archives and two observations with the Ginga satellite are used. Both the EXOSAT ME data and the Ginga data show continuously varying X-ray intensity. The Ginga observations show an increase in the first observation and a decrease in the second observation on a timescale of hours. The maximum variation observed is approximately equal to 30 percent. The X-ray source was brighter in 1988 than in 1983, with the maximum on October 8, 1988. The EXOSAT LE + ME X-ray spectra are best fit by a power law with gamma approximately equal to 1.9 and a variable component below 1 keV. The spectra observed with the Ginga are best fit by gamma approximately equal to 1.7 for E equal or greater than 3 keV and a steeper component below 3 keV. A line feature near 6 keV is observed with Ginga. ESA

N90-25905# Birmingham Univ. (England). Dept. of Space Research.
DETECTION OF HARD X RAY EMISSION FROM A TYPE 2 SEYFERT GALAXY
G. K. Skinner and C. G. Hanson *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1059-1064 (For primary document see N90-25841 19-89)
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The observations made by an X-ray telescope, flown on the Spacelab-2 Mission, of a number of clusters of galaxies are presented. Spectrally resolved images of a 6 degree square field of view in an energy range 2.5 to 32 keV were obtained. A number of serendipitous sources were detected. One such source is identified with NGC4388, a galaxy in the Virgo cluster, classified optically as a type 2 Seyfert. The hard X-ray spectrum indicates a high luminosity coupled with a high column density. A detection of faint broad wings to the H alpha line suggests that the galaxy should be reclassified as a NELG. Observations restricted to the energy range of grazing incidence telescopes such as Einstein and EXOSAT may give a misleading impression of the luminosity function of Active Galactic Nuclei (AGN). ESA

N90-25906# Nagoya Univ. (Japan). Dept of Astrophysics.
SEARCH FOR LARGE SCALE EXTENDED DIFFUSE X RAY EMISSION FROM THE COMA-A1367 SUPERCLUSTER
Y. Tawara, M. Kawada, S. Takano, Katsuji Koyama, and H. Awaki *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1065-1067 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The absolute surface brightness around the Coma-A1367 supercluster region is measured on board Ginga. Data obtained by the scanning observation was analyzed and discrete sources of down to 0.2 mCrab were selected. For the residual sky without resolved sources, the surface brightness distribution was analyzed. The data is compared with the fluctuation caused by the emission from unresolved discrete sources assuming the previously known log N-log S relation. The result shows that these distributions are consistent with each other, showing that there is no clear excess structure in the X-ray surface brightness of Coma-A1367 supercluster region. ESA

N90-25907# Utrecht State Univ. (Netherlands). Sterrekundig Inst.
A MAGNETIC FLARE MODEL FOR X RAY VARIABILITY IN AGN
Mark deVries and Jan Kuijpers *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1069-1071 Sponsored by Netherlands Foundation for Astronomical Research and Netherlands Organization for Applied Scientific Research TNO, Delft (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

A model to explain the observed, approximately 1/f, power spectrum of the X-ray variability in low luminosity Seyfert is developed. The proposed model involves a current carrying mass filament in the corona of an accretion disk. Using arguments similar to the ones for solar flares, the amount of magnetic energy which can be stored inside the tube is estimated. The equilibrium configuration of the tube is studied. It is concluded that magnetic flares can occur and the tube will subsequently break up. The kinetic energy of particle beams which result from this flare process is determined. Inverse Compton loss times and emitted power from the beams are calculated and they seem to fit the observations. Possible means of verification of the model are indicated. ESA

N90-25908# Geneva Observatory (Switzerland).
NEUTRAL COLUMN DENSITY AND SOFT EXCESSES IN ACTIVE GALACTIC NUCLEI **c90**
R. Walter and Thierry J.-L. Courvoisier *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1073-1076 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The hard X-ray spectrum of Active Galactic Nuclei (AGN) is described with a powerlaw and a low energy cold absorption. Additional soft X-ray photons are also observed in the spectra. It is shown that a separate soft X-ray component cannot compensate the absorption by a very large column density cloud completely covering the hard X-ray powerlaw. The maximum column density is less than 10 to the 23rd power/sq cm for a large class of soft component models if the hard X-ray source is totally covered. This implies a non spherical geometry for the broad line region or a complicated model to describe the X-ray spectra of AGN with at least two emission components partially covered by a large column density absorber. ESA

N90-25909# Danish Space Research Inst., Lyngby.
SPECTROSCOPY OF AGNS WITH XSPECT/SODART IN 1993
N. J. Westergaard, H. U. Norgaard-Nielsen, C. Budtz-Jorgensen, and H. W. Schnopper *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1077-1079 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The Xspect/Sodart telescope system on board the Soviet mission Spectrum-X scheduled for launch in 1993 is designed for high throughput at 7 keV. One of the two telescopes will be equipped with an objective crystal spectrometer with a spectral resolution of about 5 eV at the 6.7 keV iron line. The prime broad band spectrometer is a solid state pixel detector with resolution of 150 eV which allows good iron line detection for a large number of Active Galactic Nuclei (AGN). Position sensitive gas detectors are included. ESA

N90-25910*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE SOFT X RAY EXCESS IN EINSTEIN QUASAR SPECTRA
Belinda J. Wilkes, Jean-Louis Masnou, Martin Elvis, Jonathan McDowell (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.), and Keith Arnaud *In* ESA, The 23rd ESLAB

Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1081-1088 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes) CSCL 03A

The soft X-ray excess component is studied for a signal to noise limited subsample of 14 quasars from the WE87 sample observed with the Einstein Imaging Proportional Counter (IPC). Detailed analysis of the IPC data, combined with Einstein Monitor Proportional Counter (MPC) data where possible, and use of accurate galactic N sub H values allows estimation of the strength of any excess and improvement of constraints on the spectral slope at higher X-ray energies. A significant excess in 9 of the 14 objects is found. It is confined in all but one case to below 0.6 keV and variable in the two cases where there are multiple observations. The relation of the soft excess to other continuum properties of the quasars is investigated. ESA

N90-25911# Leicester Univ. (England). X Ray Astronomy Group.
X RAY SPECTRAL INDEX VARIABILITY IN NGC 4151
T. Yaqoob and R. S. Warwick *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1089-1094 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The results of seven Ginga observations of the archetypal Seyfert 1 galaxy, NGC 4151 are discussed. The new Ginga measurements have allowed variations in the slope of the hard power law continuum to be distinguished from changes in the intrinsic column density. The spectral index variability is investigated. It is found that the Ginga data above 4 keV require the photon spectral to vary between 1.4 and 1.7, depending on the X-ray luminosity of the source. The results of numerical calculations of the time dependent behavior of the X-ray spectrum are presented. The assumption that the X-ray power law is produced by Compton scattering of UV photons on relativistic electrons, which are mono-energetically injected into the source region, is made. The observed flux-index correlation can be reproduced for a modest change in electron compactness only for a restricted range in input parameters. ESA

N90-25912# Cambridge Univ. (England). Inst. of Astronomy.
THE ORIGIN OF THE CONTINUUM OF AGN AND THE X RAY BACKGROUND
A. C. Fabian *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1097-1104 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

Some recent results on the origin of the continuum of Active Galactic Nuclei (AGN) are reviewed. The optical continuum is shown to originate from a larger region to the X-ray emission region. Rapid X-ray variability suggests a central engine involving a compact object. Electron-positron pairs are expected to play a role in the production and reprocessing of the hard continuum, but that role is not yet understood. The observed continuum is modified by an iron emission line and a reflection hump above approximately 10 keV. An annihilation hump may be found by the next generation of hard X-ray instruments. Sources in which the reflection hump dominates may produce the X-Ray Background (XRB). The spectrum of X-rays reflected by cold matter in sources at redshifts of 1 to 2 is a remarkably good fit to the XRB spectrum above 10 keV. Quasi Stellar Objects (QSO) can produce the XRB above 3 keV. ESA

N90-25913*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EINSTEIN SSS+MPC OBSERVATIONS OF SEYFERT TYPE GALAXIES
S. S. Holt, T. J. Turner, R. F. Mushotzky, and K. Weaver (Maryland Univ., College Park.) *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1105-1110 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes) CSCL 03A

The X-ray spectra of 27 Seyfert galaxies measured with the Solid State Spectrometer (SSS) onboard the Einstein Observatory is investigated. This new investigation features the utilization of simultaneous data from the Monitor Proportional Counter (MPC) and automatic correction for systematic effects in the SSS. The new results are that the best-fit single power law indices agree with those previously reported, but that soft excesses are inferred for at least 20 percent of the measured spectra. The soft excesses are consistent with either an approximately 0.25 keV black body or Fe-L line emission. ESA

N90-25914# Oxford Univ. (England). Dept. of Astrophysics.
X RAY VARIABILITY OF ACTIVE GALACTIC NUCLEI
Ian M. McHardy *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1111-1124 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

The EXOSAT Medium Energy (ME) long looks of Active Galactic Nuclei (AGN) are reviewed. A variety of different types of behavior is seen, characterized by power spectra of different power law slopes. At high frequencies all slopes are steeper than -1 and so high frequency power is not divergent. Some sources maintain the same power spectral slope to lower frequencies but others gradually flatten and slopes near -1 are seen in the range 0.00001 to 0.0001 Hz. The variability is random, but not entirely scale-invariant. For sources with a strong soft Low Energy (LE) component there is a good correlation between the short timescale ME and LE lightcurves. There is a rough inverse correlation between luminosity and normalized variability amplitude implying that luminosity depends mainly on central mass, rather than just on accretion rate. ESA

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N90-25915*# Fermi National Accelerator Lab., Batavia, IL.
ORIGIN OF DENSITY FLUCTUATIONS IN EXTENDED INFLATION
Edward W. Kolb, David S. Salopek, and Michael S. Turner (Chicago Univ., IL.) May 1990 23 p
(Grant NAGw-1340)
(NASA-CR-182852; NAS 1.26:182852; FERMILAB-Pub-90/116-A)
Avail: NTIS HC A03/MF A01 CSCL 03B

The density fluctuations (both curvature and isocurvature) that arise due to quantum fluctuations in a simple model of extended inflation based upon the Jordan-Brans-Dicke theory are calculated. Curvature fluctuations arise due to quantum fluctuations in the Brans-Dicke field, in general have a nonscale-invariant spectrum, and can have an amplitude that is cosmologically acceptable and interesting without having to tune any coupling constant to a very small value. The density perturbations that arise due to the inflation field are subdominant. If there are other massless fields in the theory, e.g., an axion or an ilion, then isocurvature fluctuations arise in these fields too. Production of gravitational waves and the massless particles associated with excitations of the Brans-Dicke field are also discussed. Several attempts at more realistic models of extended inflation are also analyzed. The importance of the Einstein conformal frame in calculating curvature fluctuations is emphasized. When viewed in this frame, extended inflation closely resembles slow-rollover inflation with an

exponential potential and the usual formula for the amplitude of curvature perturbations applies. Author

N90-25916*# Fermi National Accelerator Lab., Batavia, IL.
EXTENDED INFLATION FROM HIGHER DIMENSIONAL THEORIES
Richard Holman, Edward W. Kolb, Sharon L. Vadas, and Yun Wang (Carnegie-Mellon Univ., Pittsburgh, PA.) Apr. 1990 27 p (Grant NAGw-1340)
(NASA-CR-180549; NAS 1.26:180549; FERMILAB-Pub-90/99-A; CMU-HEP90-09) Avail: NTIS HC A03/MF A01 CSCL 03B

The possibility is considered that higher dimensional theories may, upon reduction to four dimensions, allow extended inflation to occur. Two separate models are analayzed. One is a very simple toy model consisting of higher dimensional gravity coupled to a scalar field whose potential allows for a first-order phase transition. The other is a more sophisticated model incorporating the effects of non-trivial field configurations (monopole, Casimir, and fermion bilinear condensate effects) that yield a non-trivial potential for the radius of the internal space. It was found that extended inflation does not occur in these models. It was also found that the bubble nucleation rate in these theories is time dependent unlike the case in the original version of extended inflation. Author

N90-25763# Abastumani Astrophysical Observatory, Georgia (USSR). Town Lab.
TURBULIZATION OF SHEAR FLOWS IN ASTROPHYSICS
G. D. Chagelishvili, R. G. Chanishvili, L. G. Filipov, T. Christov (Bulgarian Academy of Sciences, Sofia.), and J. G. Lominadze *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 335-340 (For primary document see N90-25711 19-89)
Copyright Avail: NTIS HC A99/MF E06; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

N90-25827# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Astrophysik.
ASTROPHYSICAL IMPORTANCE OF THE SLIM ACCRETION DISKS
Ewa Szuszkiewicz *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 647-651 (For primary document see N90-25711 19-89)
Avail: NTIS HC A99/MF E06; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

N90-25888*# Montana State Univ., Bozeman.
ELECTRON POSITRON PAIR WINDS AND THE EDDINGTON LIMIT
K. M. Leighly and S. Tsuruta *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 969-973 Sponsored by NASA, Washington (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes) CSCL 03B

N90-25894# Consiglio Nazionale delle Ricerche, Milan (Italy). Ist. di Fisica Cosmica.
CONSTRAINTS ON THE HIGH ENERGY PROPERTIES OF ACTIVE GALACTIC NUCLEI
Sandro Mereghetti *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1001-1003 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

N90-25897# Illinois Univ., Urbana-Champaign. Dept. of Physics.
SPHERICAL ACCRETION WITH THERMAL PAIR PRODUCTION AS MODELS OF AGN
Myeong-Gu Park *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1017-1020 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

N90-25908# Geneva Observatory (Switzerland).
NEUTRAL COLUMN DENSITY AND SOFT EXCESSES IN ACTIVE GALACTIC NUCLEI
R. Walter and Thierry J.-L. Courvoisier *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 2: AGN and the X Ray Background Nov. 1989 p 1073-1076 (For primary document see N90-25841 19-89)
Copyright Avail: NTIS HC A18/MF A03; EPD, ESTEC, Noordwijk, Netherlands, 150 Dutch guilders (2 volumes)

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N90-25917*# Texas Univ., Austin. Dept. of Aerospace Engineering.
LUNAR POLAR CORING LANDER Final Report
David Angell, David Bealmear, Patrice Benarroche, Alan Henry, Raymond Hudson, Tommaso Rivellini, and Alex Tolmachoff 4 May 1990 158 p
(Contract NASw-4435)
(NASA-CR-186684; NAS 1.26:186684) Avail: NTIS HC A08/MF A01 CSCL 03B

Plans to build a lunar base are presently being studied with a number of considerations. One of the most important considerations is qualifying the presence of water on the Moon. The existence of water on the Moon implies that future lunar settlements may be able to use this resource to produce things such as drinking water and rocket fuel. Due to the very high cost of transporting these materials to the Moon, in situ production could save billions of dollars in operating costs of the lunar base. Scientists have suggested that the polar regions of the Moon may contain some amounts of water ice in the regolith. Six possible mission scenarios are suggested which would allow lunar polar soil samples to be collected for analysis. The options presented are: remote sensing satellite, two unmanned robotic lunar coring missions (one is a sample return and one is a data return only), two combined manned and robotic polar coring missions, and one fully manned core retrieval mission. One of the combined manned and robotic missions has been singled out for detailed analysis. This mission proposes sending at least three unmanned robotic landers to the lunar pole to take core samples as deep as 15 meters. Upon successful completion of the coring operations, a manned mission would be sent to retrieve the samples and perform extensive experiments of the polar region. Man's first step in returning to the Moon is recommended to investigate the issue of lunar polar water. The potential benefits of lunar water more than warrant sending either astronauts, robots or both to the Moon before any permanent facility is constructed. Author

N90-25918*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SCIENTIFIC GUIDELINES FOR PRESERVATION OF SAMPLES COLLECTED FROM MARS
James L. Gooding, ed. Washington Apr. 1990 260 p
(NASA-TM-4184; S-604; NAS 1.15:4184) Avail: NTIS HC A12/MF A02 CSCL 03B

The maximum scientific value of Martian geologic and atmospheric samples is retained when the samples are preserved in the conditions that applied prior to their collection. Any sample degradation equates to loss of information. Based on detailed review of pertinent scientific literature, and advice from experts in planetary sample analysis, number values are recommended for key parameters in the environmental control of collected samples

with respect to material contamination, temperature, headspace gas pressure, ionizing radiation, magnetic fields, and acceleration/shock. Parametric values recommended for the most sensitive geologic samples should also be adequate to preserve any biogenic compounds or exobiological relics. Author

N90-25919*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
REPORTS OF WORKSHOPS ON PROBE MEASUREMENTS OF PARTICLES AND RADIATION IN THE ATMOSPHERE OF TITAN
Boris Ragent, comp. and ed. and Byron L. Swenson, comp. and ed. May 1990 50 p Presented at the Workshop on the Measurement of Particulate Matter in the Atmosphere of Titan, Aug. 1986; and Workshop on the Measurement of Radiation in the Atmosphere of Titan, Dec. 1986
(NASA-TM-102218; A-89217; NAS 1.15:102218) Avail: NTIS HC A03/MF A01 CSCL 03B

The planned 1995 joint ESA-NASA Cassini mission to the Saturnian system will include an atmospheric probe to be dropped into the atmosphere of Titan for in situ measurements during descent. Because of the unique properties of the Titan atmosphere it is necessary to consider the peculiar requirements for such measurements and applicable techniques. The proceedings of two workshops dealing with the measurement of particles and radiation in the atmosphere of Titan are presented in two parts. The first part dealt with the measurement of particulate matter in the atmosphere of Titan. The second part dealt with the measurement of radiation in the atmosphere of Titan. The proceedings were first published and distributed informally, and are presented with only minor editorial changes. In the report of the particulate matter workshop, discussions of the mission background, the importance of the measurements, and descriptions of the desired information are followed by a description of appropriate measurement techniques and conclusions and recommendations. The proceeding for the workshop on radiation measurement and imaging contains a discussion of the importance of radiation measurements and imaging, and presents a summary of participants' experience with such measurements made from entry probes. This is followed by a description of appropriate measurement techniques and conclusions and recommendations. Author

N90-25920# Lawrence Livermore National Lab., CA. Special Studies Program.
MARS IN THIS DECADE: THE GREAT EXPLORATION
Roderick Hyde, Muriel Ishikawa, and Lowell Wood 1990 26 p Presented at the 6th National Space Symposium of the United States, Colorado Springs, CO, 9-11 Apr. 1990
(Contract W-7405-eng-48)
(DE90-011232; UCRL-JC-103503; CONF-9004204-1) Avail: NTIS HC A03/MF A01

This paper discusses the great exploration plan to reach the planet Mars in this decade. The costs and procedures are also discussed. DOE

N90-25921*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ASSEMBLY VS. DIRECT LAUNCH OF TRANSFER VEHICLES
Stephen J. Katzberg and E. Brian Pritchard Jun. 1990 22 p
(NASA-TM-102686; NAS 1.15:102686) Avail: NTIS HC A03/MF A01 CSCL 03B

A top level assessment is performed of the relative impacts of on-orbit assembly of the lunar or Mars transfer vehicles versus direct launch. The objective is to identify the major option paths for the Earth-to-orbit, ETO, transportation systems. Heavy lift launch vehicles, if large enough, could reduce or eliminate on-orbit assembly. However, with every new approach, there are always counter-balancing considerations and it is the objective to begin the delineation of the necessary follow-on trade study issues. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N90-25922*# Tufts Univ., Medford, MA.
U. RADIO EMISSION FROM QUIESCENT FILAMENTS
Kenneth R. Lang Sep. 1989 14 p Presented at the 117th IAU Colloquium on Dynamics of Prominences, Hvar, Yugoslavia, 25-29 Sep. 1989
(Grants NAG5-501; AF-AFOSR-0147-89; NSF INT-86-02285; CNRS-920038)
(NASA-CR-186538; NAS 1.26:186538) Avail: NTIS HC A03/MF A01 CSCL 03B

Full-disk Very Large Array (VLA) synthesis maps of the quiet Sun indicate that filaments can be seen in emission at 91.6 cm wavelength; they are detected in absorption at shorter microwave wavelengths. The 91.6 cm emission has a brightness temperature of T sub B = 3 x 10(exp 5) K. It is hotter, wider and longer than the underlying filament detected at H alpha wavelengths, but the similarity between the shape, position, elongation and orientation of the radio and optical features suggests their close association. The 91.6 cm emission is attributed to the thermal-bremsstrahlung of a hot transition sheath that envelopes the H alpha filament and acts as an interface between the cool, dense H alpha filament and the hotter, rarefied corona. The transition sheath is seen in emission because of the lower optical depth of the corona at 90 cm wavelength, and the width of this sheet is 10(exp 9) cm. A power law gradient in pressure provides a better match to the observations than a constant pressure model; definitive tests of theoretical models await simultaneous multi-wavelength studies of filaments at different observing angles. When the thermal bremsstrahlung is optically thin, the magnetic field strength in the transition sheath can be inferred from the observed circular polarization. Variable physical parameters of the sheath, such as width, electron density, and electron temperature, can explain controversial reports of the detection of, or the failure to detect, the meter-wavelength counterpart of H alpha filaments. Author

N90-25923*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
NASA MARSHALL SPACE FLIGHT CENTER SOLAR OBSERVATORY REPORT, JANUARY TO DECEMBER 1989
James E. Smith Jun. 1990 68 p
(NASA-TM-100404; NAS 1.15:100404) Avail: NTIS HC A04/MF A01 CSCL 03B

A description is provided of the NASA-Marshall's Solar Vector Magnetograph Facility and a summary of its observations and data reduction during January to December 1989 is given. The systems that make up the facility are a magnetograph telescope, and H-alpha telescope, a Questar telescope, and a computer code. The data are represented by longitudinal contours with azimuth plots. Author

N90-25924# Bern Univ. (Switzerland). Div. of Solar Observations.
BERNE SOLAR OBSERVATIONS: DATA FOR JULY TO DECEMBER 1989
A. Magun, M. Fuhrer, G. Bruggmann, M. Graeter, S. Eder, and R. Herrmann Dec. 1989 83 p
(Rept-56; ETN-90-97090) Avail: NTIS HC A05/MF A01

Data on solar radio observations and on solar flares at H alpha are listed. The radio frequency range is 3.1 to 92.5 GHz. The events were visible on chart records on at least one frequency. An imaging spectrograph with charged coupled device matrix sensor and digital registration are applied for line profile observations. The flux density of bursts in percent of the Sun before and after the burst are given. ESA

N90-25560*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SUNSPOT PREDICTION USING NEURAL NETWORKS
James Villarreal and Paul Baffes *In its* Third Annual Workshop

on Space Operations Automation and Robotics (SOAR 1989) Mar. 1990 p 525-535 (For primary document see N90-25503 19-59)
Avail: NTIS HC A99/MF A04 CSCL 03B

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N90-25925*# Alabama Univ., Huntsville. Cosmic Ray Lab.
SPACE RADIATION STUDIES Final Report, 22 Jul. 1983 - 30 Jun. 1989
1989 21 p
(Contract NAS8-35354)
(NASA-CR-183991; NAS 1.26:183991) Avail: NTIS HC A03/MF A01 CSCL 03B

Two Active Radiation Dosimeters (ARD's) flown on Spacelab 1, performed without fault and were returned to Space Science Laboratory, MSFC for recalibration. During the flight, performance was monitored at the Huntsville Operations Center (HOSC). Despite some problems with the Shuttle data system handling the verification flight instrumentation (VFI), it was established that the ARD's were operating normally. Postflight calibrations of both units determined that sensitivities were essentially unchanged from preflight values. Flight tapes were received for approx. 60 percent of the flight and it appears that this is the total available. The data was analyzed in collaboration with Space Science Laboratory, MSFC. Also, the Nuclear Radiation Monitor (NRM) was assembled and tested at MSFC. Support was rendered in the areas of materials control and parts were supplied for the supplementary heaters, dome gas-venting device and photomultiplier tube housing. Performance characteristics of some flight-space photomultipliers were measured. The NRM was flown on a balloon-borne test flight and subsequently performed without fault on Spacelab-2. This data was analyzed and published. Author

N90-25926# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
ELEVENTH EUROPEAN COSMIC RAY SYMPOSIUM
Mar. 1989 176 p Symposium held in Balatonfuered, Hungary, 21-27 Aug. 1988
(DE90-611419; INIS-mf-11571; CONF-8808279) Avail: NTIS HC A09/MF A01

The biannual symposium includes all aspects of cosmic ray research. The scientific program was organized under three main headings: cosmic rays in the heliosphere; cosmic rays in the interstellar and extragalactic space; and Properties of high energy interactions as studied by cosmic rays. DOE

N90-25927# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
ELEVENTH EUROPEAN COSMIC RAY SYMPOSIUM
Aug. 1988 74 p Symposium held in Balatonfuerd, Hungary, 21-27 Aug. 1988
(DE90-611424; INIS-mf-11572; CONF-8808279) Avail: NTIS HC A04/MF A01

The biannual Symposium includes all aspects of cosmic ray research. The scientific program was organized under three main headings: cosmic rays in the heliosphere, cosmic rays in the interstellar and extragalactic space, and properties of high-energy interactions as studied by cosmic rays. Selected short communications out of 114 contributed papers were indexed separately for the INIS database. DOE

N90-25805*# Northwestern Univ., Evanston, IL. Dept. of Physics and Astronomy.
GAMMA RAY BURSTS FROM MAGNETOSPHERIC PLASMA OSCILLATIONS
Fulvio Melia *In* ESA, The 23rd ESLAB Symposium on Two Topics in X Ray Astronomy. Volume 1: X Ray Binaries Nov. 1989 p 525-530 Sponsored by NASA, Washington and Sloan (Alfred P.) Foundation (For primary document see N90-25711 19-89)
(Grant NSF PHY-88-57218)
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N90-25806# Osaka Univ., Toyonaka (Japan). Dept. of Physics.
IS THE HARD TAIL OF X RAYS FROM GX339-4 A COMPTON SCATTERING COMPONENT
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Fred M. Fetrow, comp., ed. Dec. 1989 274 p
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The role of research at the Naval Academy is to maintain an atmosphere of scholarly excellence in which midshipmen seek knowledge. Discipline and curiosity are both essential to a naval officer, as to any educated man or woman, and the balance of these traits determines the character of our graduates. The information presented describes the research projects and productivity of our faculty and midshipmen for the 1988 to 1989 academic year. Each of sixteen academic departments in five divisions: engineering and weapons, english and history, mathematics and science, professional development, and U.S. and international studies are presented, showing the growth of research by our faculty. M.G.

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Jan. 1989 155 p
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The publication of this RE and D Plan represents a new start in the revitalizaiton of the FAA's RE and D Program. A program was developed to work more closely with the aviation industry and to be responsive to the Aviation Safety Research Act of 1988. The plan also provides a balance between near- and long-term research activities to provide effective solutions to immediate problems and provide a base for the aviation system of the 21st century. Author

N90-25931# Federal Aviation Administration, Washington, DC.
THE FEDERAL AVIATION ADMINISTRATION PLAN FOR RESEARCH, ENGINEERING AND DEVELOPMENT. VOLUME 2: PROJECT DESCRIPTIONS
Jan. 1989 264 p
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The FAA RE and D plan addresses the present and future needs of the national aviation system through fulfillment of the FAA's major mission areas. Detailed descriptions are presented of the projects included in the RE and D Plan. For planning purposes, the time frame is broken into three windows, with 1989 to 1995 composing the near term, 1996 to 2005 the mid-term, and 2006 to 2015 the far term. The project plans described were organized into the following 13 technical areas: system studies; air traffic control; communications; navigation and landing; surveillance; aviation weather; satellite applications; airborne systems; airports; aircraft safety; aviation medicine; security; and human systems and operations. Author

N90-25932# European Space Agency, Paris (France).
SECOND MEETING OF THE SPACE AGENCY FORUM ON THE INTERNATIONAL SPACE YEAR (SAFISY)
R. Sliwa, ed. Mar. 1990 85 p Meeting held in Frascati, Italy, 2-3 May 1989
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The talks and papers presented at the second meeting of the International Space Year (ISY) are presented. Projects planned for the ISY by the space agencies of the different countries represented are described. The perspective of developing countries on the ISY is discussed. The proposals endorsed at the meeting include plans for extensive collaboration on such subjects as: space data for global change, global information system tests and global change outreach. The need for professional training in the methods and applications of remote sensing and natural resources development is stressed. ESA

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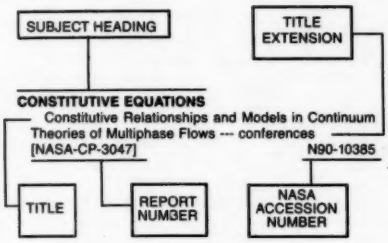

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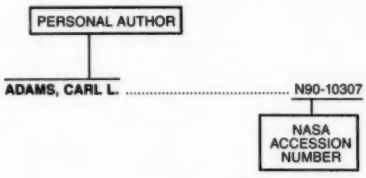

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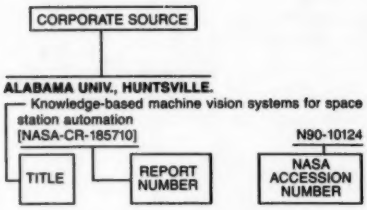

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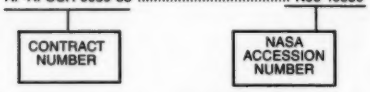

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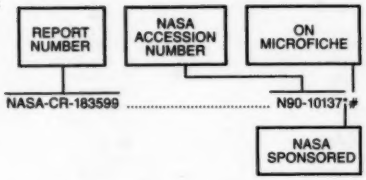

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For related information see also *Astronautics.*

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